ASIATICK RESEARCHES:

OR

TRANSACTIONS

OF THE

SOCIETY,

INSTITUTED IN BENGAL,

FOR ENQUIRING INTO THE

HISTORY AND ANTIQUITIES, THE ARTS, SCIENCES, AND LITERATURE,

OF

ASIA.

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TRANSACTIONS

OF THE

ASIATICK SOCIETY.

I.

Account of a Discovery of a modern imitation of the VÉDAS, *with Remarks on the Genuine Works.*

BY FRANCIS ELLIS, ESQ.

IN proceeding to give an account of an instance of literary forgery, or rather, as the object of the author or authors, was certainly not literary distinction, of religious imposition without parallel; I shall in the first instance, confine myself to the description of the writings in which it is contained, adding, as specimens, a few passages selected from them, and such remarks as are necessary for the distinct elucidation of the subject: nor, as my sole object is to shew what these writings really are,

a statement of their contents, as simple as prespicuity will allow, will effect this more readily than a lengthened dissertation; though the subject, calculated as it is to excite serious reflection, is well worthy of a more detailed consideration.

In the year 1778, a book was printed at *Paris*, entitled "*L'Ezour* "*Védam*, ou Ancien Commentaire du *Védam*, contenant l'exposition des "opinions religieuses et philosophiques des *Indiens*. Traduit du Sam-"scretam par un Brame." The origin of this work is stated in the following extract from the preface: "Cet ouvrage vient originairement "des papiers de M. Barthelemy, second membre du conseil de *Pondi-*"*cheri*; M. De Modave, connu par son esprit et par ses services, en "apporta des Indes une copie, dont il fit présent a M. De Voltaire, qui "l'envoya en 1761 a la Bibliotheque de Roi de France. Cet illustre "ecrivain (Vide Siecle de Louis XV. Chap. XXIX. Not.) nous "apprend que ce livre a été traduit du Samscretam par le grand prêtre "ou archi-brame de la pagode de *Cherengham*, vieillard respecté par sa "vertu incorruptible." The note in Voltaire's work here referred to, is as follows: "Le grand prêtre de *L'ile Cherengham*, dans la pro-"vince d'Arcate, qui justifia le Chevalier Lass, contre les accusations "du Gouverneur Dupleix, etait un vieillard de cent années, respecté "par sa vertu incorruptible. Il savait le Français et rendit de grands ser-"vices a la compagnie des Indes. C'est lui qui traduisit *L'Ezour* "*Védam*, dont j'ai remis le manuscript a la Bibliotheque du Roi."—The copy of this work thus traced through the hands of Voltaire to the library of the king of *France*, not being complete, the editor adds:

" Nous avons supplié ce qui manque a cette copie par celle qu'en avoit " faite M. ANQUETIL DU PERRON, egalement distingué par son savoir et " célèbre par ses voyages," &c. It is clear, therefore, that VOLTAIRE considered this an authentic work, and actually, as stated to be, a Commentary on the *Védam*, and ANQUETIL DU PERRON, who had passed many years of his life in India and professed a profound knowledge of its religion, antiquities and literature, assisted in bringing it forward, as such, to the world. Now, observe what M. SONNERAT says on this subject: " Il faut " bien se garder de mettre au nombre des livres canoniques indiens *L'Ezour* " *Védam*, dont nous avons la pretendue traduction a la Bibliotheque du " Roi, et qui a été imprimée en 1778.—Ce n'ést bien certainement pas " l'un des quatres *Védams*, quoiqu'il porte le nom; *mais plutôt un livre* " *de controversie ecrit a Masulipatam par un Missionnaire*. C'est une " réfutation de quelques Pouranons a la louange de VICHENOU, qui sont " de bien des siecles posterieurs aux *Védams*. *On voit que l'Auteur* " *a voulu tout ramener á la religion Chrétienne, en y laissant cepen-* " *dant quelques erreurs, a fin qu'on ne reconnût pas le Missionnaire* " *sous le manteau Brame*. C'est donc a tort que M. DE VOLTAIRE et " quelques autres donnent á ce livre une importance qu'il ne merite pas " et le regardent comme canonique."—M. SONNERAT'S representation of the work is perfectly correct, except that he must be mistaken in saying it was written at *Masulipatam*; all the *Sanscrit* terms used in it, being altered according to the *Bengáli* pronunciation, as will be more particularly shewn hereafter. An inspection of the printed book, which was a short time in my possession, led me, therefore, to conclude, that this work was written in the *Bengáli* language by one of the missionaries and re-

composed by the author in *French:* for, as the object of it is undoubtedly that, stated by M. SONNERAT, namely to refute the doctrines of the *Purānas* and to lead indirectly to the introduction of Christianity; it was evident, that to attain this object, it must have been originally composed in one of the *Indian* dialects.

AT the time this inference was drawn, I was not aware that there existed any means of verifying it, and it was chance that enabled me to ascertain that the original of this work still exists among the manuscripts in the possession of the *Catholic* missionaries at *Pondicherry*, which are understood to have originally belonged to the society of *Jesuits*. Besides the *Ezour Védam*, there are, also, among these manuscripts, imitations of the other three *Védas;* each of these are in *Sanscrit*, in the *Roman* character, and in *French*, these languages being written on the opposite pages of the manuscripts, to give them the appearance of originals with translations annexed. As the best way of proving to those competent to form an opinion on the subject, what these works really are, I shall, previously to noticing the others, make an extract from the commencement of the "*Chamo Bedo*," in both languages, giving the *Sanscrit* as it appears in the work, and in its proper orthography, and I shall then state the substance of each chapter of the five books into which the work is divided, from the abstracts in the margin of the manuscript. I must premise, however, that the corrupt pronunciation of the *Sanscrit* and the peculiar mode of orthography, adopted by the author to express it, has made the reduction of the *Sanscrit* to its natural state, difficult and liable to error.

THE supposed translation of the "*Chamo Bedo*,"* (*Sáma Véda.*) thus commences:

"ZOIMINI touché† de compassion et pressé du désir de sauver les
" hommes qui dans ce siécle de peché s'estoient fait des fausses idées de
" la divinité entreprend de les rappeller, a l'idée du vray dieu en retraçant
" a leurs ieux ce que fait son essence et son caracthere, et d'abord il com-
" mence par lui offrir les hommages de la maniere qui suit. Adoration
" au dieu qui a mille tetes; il est le vengeur du crime le soutien de tout ce
" qui existe et le gourou du monde, il est eternel de sa nature; il n'a jamais
" eu de principe; il n'aura jamais de fin et ne fut jamais sujet au prestige
" une syllabe compose son nom; il est le createur de toutes choses; il est
" l'etre au dessus de tous les etres, et le dieu de toute verité; il est l'etre par
" lui mesme; il est le voy de voys et le maitre des maitres et le lieu ou il fait
" sa demeure est le lieu du vray bonheur; il est esprit de sa nature toujours
" le mesme et toujours venerable; il ne prouve dans lui ni changement ni
" vicissitude; il est heureux et heureux par lui mesme; il est en fin le com-
" ble de toutes perfections et au dessus de toutes nos connoissances, c'est
" au dieu qui a pour ceux qui l'envoquent la tendresse d'un vray pere
" qui j'offre mes adorations et mes hommages et c'est par la que je com-
" mence le livre que je vay mettre au jour; puissent tous les hommes
" imiter cet example et commencer tous leurs ouvrages par offrir leurs

* This title is, also, written "*Chámo Védan.*"

† The orthography and wording of the original have been carefully retained in this extract.

" hommages au vray dieu—Dans ce moment narajon qui avait entendu
" parler des differentes metamorphoses de la divinité et qui avait donné
" dans toutes ces reveries se present les mains jointes devant ZOIMINI, le
" maitre du Vedon, le pria de la lui enseigner et lui dit."

N. " *Je suis seigneur un hommè tout livre a l'erreur je m'adresse a vous comme au plus eclairé de tous les hommes pour vous prier de m'enseigner la route que je dois desormais suivre pour me sauver.*"

Z. " *Il n'est point de vraye connoissance que cette que nous communiquer Le Vedon, Le Vedon est ce qu'il y a de plus grand. de plus sublime, de plus caché, et les hommes livrés a l'erreur ne furent jamais en etât ne de le gouter ni de le comprendre.*"

THE *Sanscrit* of the preceding is as follows: the first line is written exactly as in the original, in the second the orthography is corrected, a few syllables conjecturally supplied, and a literal translation, according to this reading, subjoined.

PROSE

Poromo karoniko zaimeni koli kolmocho,
Parama cárinico jaimenih cali calmasha.
The most merciful JAIMENI knowing the impurity of CALI.

Bibranto sedocho brommono ozatartoto,

Vibhránta chétasah brahmanah ajnyátárthatah,

The minds of men were much confounded, and that from the want of a knowledge of the deity.

Ognano bolon ouddaron monochi bibedio,

Ajnyána uddháram manasi vivédya.

The power of ignorance had sprung in their minds.

Adohu brommo sorgion boktun arebe,

A'dau brahmacharyam vactum arebhé.

Began to declare the duties of *Brahmachari.*

Totrádohu poromanando siteno poromechoron nanamo,

Tatrádau paramánanda chitena paraméswaram nanáma.

Then in the beginning, with a most delighted mind, he worshipped the most high GOD.

VERSE

I.

Oum choosero chirichan debon duxto nigroho karokon,

Om Sahasra sirsham devam dush'ta nigraha caracam.

OM! the god with a thousand heads, who causeth the destruction of the wicked.

2.

Stapokon zontou adinam pronotochi zogaot gurum,

Sthápacam jentu adinám pranatósmi jagat gurum.

The establisher of all creatures, HIM, I reverence the chief of the world.

3.

Adaram chorbo lokanam anadi nidonon probun,

A'dháram serva lócánám anadi nidhanam prabhum.

The supporter of all worlds, the LORD without beginning or end.

4.

Obedion chorbo majanam pronotochi mohotprobun,

Abhédyam serva máyanàm pranatósmi mahatprabhum.

HIM, not subjected to all the *Máyàs*, I reverence the great LORD.

5.

Okioram poromon nition bichuakion bichuochon bobun,

Acsharam paramam nityam viswáchyam viswásám bhuvam.

The indestructible, the highest, the eternal, HIM, who is called the universe, the station of the happiness of the universe.

6.

Chorbo totuamojon debon pronotochi poratporon,

Serva tatwa mayam dévam pranatósmi parátparam.

The GOD, who energizes all elements, HIM, I reverence, the highest of the high.

7.

Prodono pourouchon chiddon chorbo gnanoiko koronon,

Pradhána purusham siddham servajnyan'aica caranam.

The chief male, the fixed, the sole cause of all knowledge.

8.

Porat porotoron debon pronotochimoha probun,

Parot paratarain dévam pranatósmi mahúprabhum.

The most high GOD, him I reverence, the great LORD.

9.

Porongioti porom damopobitron poromon podon,

Paramjyoti param dhámah pavitram paramam padam.

The highest light, the highest throne, the pure, the highest place.

10.

Chodoiko babon poromon pronotochi mahachojon,

Sadàica bhàvam paramam pranatòsmi mahu sayam.

HIM, whose nature never changes, the most high, I reverence HIM, whose ideas are sublime.

11.

Tonchodanondo sit matron serextanam sorbo serexton,

Tam sadananda chin mátram sreshtanàm sarva sreshtatam.

That pure spirit which is ever happy, of excellent things the most excellent.

12.

Nirgonnon nioton naton pronotochi kritanzoli,

Nirgunam niyatam nat'ham pranatòsmi critanjalih.

HIM, who is without qualities, who never varies, the LORD, him I worship with joined hands.

13.

Porecho poremonodechoronagoto bossolo,

Parèsa paramananda saranagata vatsala.

O thou, the high LORD, O thou the pre-eminently happy, thou who shewest mercy to those who take refuge with thee.

14.

Trahiman korono chindo mootito namostute,

Trahi màm carunà sind'ho' muctidàya namastute'.

Deliver me, O sea of mercy! for the sake of eternal beatitude, I worship thee.

PROSE.

Iti [illegible]-chi [illegible]n bromono toutocho,

It[illegible] [illegible]a [illegible]sh'ar tham brahma stutasya.

T[illegible] was declared as an admonition to the disciples of HIM, who thus lauded the Supreme.

Itoch[illegible] [illegible]omoje nanabotaro serabome beto naraj no [illegible]nalio,

Etasmin samaye nan'a catura [illegible]sraran [illegible] N[illegible]ayana ma[illegible]ahan.

At that time NARAYANA, who had [illegible] [illegible] ;

Obapotochat kretanzoli boutua bedo gourun,

Avápatasmat critánjelih bhútwá Véda gurum.

Approached the great one and, reverently joining his hands, he drew near to the teacher of the *Véda*,

Zoimeni zichi boron prortoyo,

Jaimeni rishi varam prapaya.

To JAIMENI, the select of the sages.

VERSE

15.

N. Chondino bimoundatmua no kinchit kritoban boula,

Aham dína vimudatma na cinchit critavan bhuei.

I am a wretch whose mind is void of understanding, who have done no good in the world.

16.

Kenome toronam noto' koipoja bedo bistoron,

Cena me taranam natha cripaya vada vistaram.

Wherefore, O LORD! have pity on me, and tell me, at length by what means salvation *may be obtained.*

17.

Ton bina gnyato loke nobidionte kodassona,

Tam vina jnatayo loce na vidyante cadachana.

Besides THEE, there is none in the world, who knows any thing respecting it.

18.

Z. Bina bedat notognanam bedohi dourguomon poron,

Viná védát natajnyánam védahi durgamam param.

The knowledge of that, *can be obtained* only by the *Véda*, but a knowledge of the *Véda* is most difficult to acquire.

19.

Pochondonadicarisso, bedo chastro chemussojon,

Páshandanástic'árch, han Véda Sástra samuchchayam.

Heretics and atheists have confused the whole of the *Véda Sástra.*

THIS specimen of the original will suffice to convince those acquainted with the *Sanscrit* and with the changes it undergoes in the *Prácrits* and spoken dialects, that this work, whether the author were a Native or a European, must either have originated in the provinces of *Bengal* and *Orissa*, or have been composed by some one, who had there learned the rudiments of the *Sanscrit.* As the establishment of this fact will tend materially to facilitate the tracing of these forgeries to their origin, I shall, also, endeavor to prove it to the satisfaction of those not acquainted with the *Sanscrit* and its derivative dialects. The *Bengáli*, with which the *Uddaya* corresponds in most points to which the following observations extend, is written in a character derived in form and system from the *Nágari*, but rejecting many of the letters of the latter, permuting others in a very corrupt but uniform mode: the more pro-

minent of these changes are the rejection* of the hissing and harsh sibilants, being the thirty-first and thirty-second consonants of the *Nágari* system, and the substitution for them of the soft sibilant, expressed throughout these works by the *French ch;* the utter rejection of *va* as a letter and the substitution of *ba* in all cases where it ought to occur; the conversion of the first vowel, *a* short, into *o*, of the diphthong *ai* into *oi;* of *ya* into *ja*, (written in the preceding extract *gea*) of *cha* into *sa*, *ja* into *za*, and of *csha* into *cya* (*kia*). A comparison of the original extract with the interlined correction will furnish repeated examples of each of these changes—thus the soft sibilant *ch* is written for the hissing sibilant in the word *chorbo*, properly *sarva*, and for the harsh sibilant in *richi*, *rishi;* in the first syllable of *chirichon* (*śirsham*) it is used for the corresponding *Sanscrit* letter, but in the last it is substituted for the harsh sibilant. In words *bedo* (*Véda*), *debo* (*déva*), and many others *va* is converted to *ba;* *majanam* (*máyánàm*) is an instance of the conversion of *yà* into *ja;* *somussojon* (*samuchchayam*) of *cha* into *sa* and (ZOIMENI), (JAIMENI), of *ja* into *za* and of *ai* into *oi;* *okioram* for *acsharam*, affords an instance of the lapse of the *csha.*—All the *Pseudo-Védas* conform, in the *Sanscrit* part to these changes as uniformly as they will be found to take place in the preceding extract; and in addition, however, to these dialectic variations the author has still further disfigured the language by dropping all the aspirated letters, as *cha*, *gha*, *chha*, &c. and by retaining only one of many compound consonants, as in the word written *tochin* for ...*min*, &c.

* SEE Dr. CAREY's *Bengáli* Grammar for the several changes here noticed in the latter part of Sect. I. " On the pronunciation of the letters," from page 4 to 10.

THE following abstracts of the several chapters are inserted in the margin of the *French* part and are evidently intended for the information of the *European* reader only, as the views of the author are more explicitly declared in them, than can possibly be gathered from the text either of the original or translation.

“ LIVRE 1^{er}—CHAPITRE 1^{er}.”

“ CONTIENT l’exorde de tout l’ouvrage, le motif qui a engagé ZOIMENI “ a le composer—Dedicace de son Livre a L’Etre Supreme-caractere “ du vrai gourou et ses fonctions.”

“ CHAPITRE 2^{nd}.”

“ QUI contient une grande Idée de Dieu et de ses attributs et refute la “ fausse idée que les faux *Védes* donnent de la Divinité, abregé de la “ creation du monde.”

“ CHAPITRE 3^{me}.”

“ TRAITE de la creation fabuleuse des faux *Véds*, fait la refutation; il “ traite ensuite, de la vertu et de ceux qui sont habiles et inhabiles a lire “ le *Védam*.”

“ CHAPITRE 4^{me} ”

“ PARLE du vrai Dieu et du culte qu’on doit lui rendre-en etablissant “ le cutte du vrai Dieu, il condamne le culte que NARAION veut qu’on “ rende a *Vichnou et Chib*.”

" LIVRE 2me—CHAPITRE 1er."

" PARLE des 5 opinions fabuleuses de la Creation: la 1ere appellée Pad-
" mokolpo, attribuée a VICHNOU; la 2nde a la Tortuë; la 3me au Cochon; la
" 4me a GONECH; la 5me a la Deesse BIROZA; ensuite il parle de la 2nde Crea-
" tion, attribuée a la Tortuë, du Deluge, de la Metamorphose, de L'Etre
" Supreme en Tortuë, de la Creation d'une fille avec laquelle la Tortuë
" se marie, des 3 mondes qui naissent chacun d'un Oeuf que la fille
" produit au bout d'un million d'ans—du 1er sortit le Chouargam un
" million d'années apres sortit la Terre, du 2nd Oeuf, &c. elle crea dans
" le Chouargam, Kachiopo et Odite qui eurent pour enfans Bamon, Indro,
" Coubero, les Geants, de Bamon est la caste des Brames, d'Indro celle
" des Roys, de Coubero celle des Marchants, and des Geants celle des
" Choudras."

" CHAPITRE 2me."

" RENFERME la refutation du precedent—belle Idée de Dieu tirée du
" vrai *Védam*.

" CHAPITRE 3me."

" CONTIENT la continuation de la Metamorphose de L'Etre Supreme en
" Tortuë, il renferme le systeme des Metamorphoses totales et partiales, c'est
" a dire qui renferment toute la divinité; systeme qu'on trouvera bien
" developpé dans *L'Odorbo Bedo* ou 4me *Véd*, Liv. qui en parle *ex pro-*
" *fesso*, refutation de ce systeme—beau caractere du vrai dieu. ZOIMENI
" fait dans ce chapitre NARAION auteur du faux *Chuma Véd*, remarque
" essentielle."

" LIVRE 3me—CHAPITRE 1er."

" CONTIENT la Creation attribuée au Cochon, c'est BRAMMA ou l'Etre
" Supreme, sous le nom de CHIB qui se metamorphose en Cochon; et
" PARVATI sa famme en Truye pour retirer et soutenir la Terre,
" description du Lieu qu' habitait CHIB."

" CHAPITRE 2nd."

" CONTIENT la refutation du precedent."

" CHAPTRE 3me."

" CONTIENT la description de la creation que fit le Dieu Cochon, le
" fond du systeme de cette creation se trouve dans le corps du vrai
" *Ezour Véd.*"

" LIVRE 3me—CHAPITRE 4me."

" EST la refutation du precedent."

" LIVRE 4me—CHAPITRE 1er."

" CONTIENT le mariage de CHIB L'Etre Supreme la naissance de son
" fils GONECH, la perte de sa tête, a la quelle CHIB substitua celle d'un
" elephant et le commencement de la creation attribuée a GONECH."

CHAPITRE 2nd."

" EST la refutation des fables du precedent."

CHAPITRE 3me."

" PARLE de la maniere dont GONECH fit les 3 mondes avec ses 3 yeux."

" du [illegible] il fit le Chouargam; de celui du Milieu, la Terre; du 3me le
" Patalam, il crea les 3 *Gounalous*,* il plaça la Chotagunam dans le
" Chouargam, le Rozo Gounam sur la Terre et le Tomo Gounam dans
" le Patalam ensuite il fait la description du Patalam qu'il partage en 7
" parties comme il a partagé ce devant dans les livres precedents, la
" Terre en 7 Isles, il assigne le nom, la figure, et les mœurs des
" habitans de chacune de ces parties—ce chapitre finit par deux opinions
" sur la nature de l'ame les uns veulent qu'elle soit immortelle, sans
" principe et sujetté aux Gounalous et qu'elle se reunisse et s'identific
" avec Dieu en tems du Deluge, c'est a dire a la fin de chaque age;
" le autres qu'elle soit mortelle et qu'elle ne soit par rapport a Dieu
" que ce qu'est au soleil son image quand il se peint dans l'eau."

" CHAPITRE 4me."

" EST la refutation du precedent. ZOIMEHI auteur du vrai *Chama*
" *Védam* combat comme faux le systeme qui fait l'ame une emanation
" de Dieu qui va se reunir a Dieu a la fin de chaque age; systeme
" qu' *Onguira*, auteur de vrai *Odorbo Bédo*, paroit adopter comme on
" le peut voir au lieu."

" N. PREUVE evidente que le vrai *Chama Védam* et le vrai *Odorbana*
" *Védam* ne sont pas sortis de la meme main et que le Brame qui les a
" communiqués n'en est pas l'auteur."

* THIS word is the plural termination of the *Telugu* language.

" LIVRE 5me, CHAPITRE 1er."

" TRAITE de la Creation par la Deesse BIROZA et des 3 Gounalous, " ensuite vient la refutation, et ce que c'est 3 Gounalous selon les " vrais *Védams*, ce qu'ils en disent a donné occasion aux fables des faux " *Véds* sur les Gounalous; le chapitre finit par enseigner ce qu'il faut " faire pour se sauver."

" CHAPITRE 2me."

" DEVELOPPE le systeme de Dieu autant qu'ame universelle, il parle " aussi des 5 Elements et des 5 Ceiux, ou des 5 Especes des Bouhuns " aprés la mort, dont le plus parfait est l'identitè avec Dieu, ce systeme " est bien developpé."

" CHAPITRE 3me."

" REFUTE le precedent."

" CHAPITRE 4me."

" PARLE de la maniere dont BIROZO crea tout—refutation—nouvelle " idée de Dieu, de la Loi qu'il donna au 1er homme, de l'amour " parfait, du ciel ou de l'eternité bien heureuse, ce qu'il faut faire " pour l'obtenir; de la nature de Dieu et de l'ame, le tout tiré du " vrai *Védam*."

THE following is a list of the manuscripts and a sketch of their contents. I have for the sake of easy reference numbered them as chance brought them to notice during the examination, but the originals are not so distinguished.

No. 1.

A COPY of the *Ezour Védam* in *French* only, probably the original whence the transcript sent to *France* was made, as the original title of the work, "*Jozour Béd*," which appears at the head of the first page has been crossed with a pen and the words "*Ezour Védam*," as it stands in the printed book, written above it. The former is the mode in which the *Sanscrit* name would be written and pronounced in the dialect of *Bengal*, and is in conformity with the orthography of the rest of the work; the substituted title approaches the pronunciation of the inhabitants of the South of *India*, but is still incorrect, as it ought to be written *Yejur** *Védam*. The contents of this manuscript appear to be exactly the same as the printed work: as I had not, however, an opportunity of perusing the whole of the latter, I can only speak decidedly of the former part which is the same as the manuscript. It consists wholly of a colloquy between CHOUMONTO (SUMANTA) and BIÁCH (VYÁSA) and is divided into six books, of which the 1st contains six chapters, the 2d, 3d, 6th and 7th six, and the 4th and 5th five each.

No. 2.

THIS manuscript is a quarto volume bound in black leather. It contains that part of the "*Zozochi Karmo Bédo*," which treats on the *Sandhya*, &c. the whole of the *Ezour Védam*, as contained in the preceding manuscript, and the supplement of the *Ezour Védam*. All in

* THE crude noun is *Yejush*, the final consonant of which is under certain rules, convertible

French only without the *Sanscrit.*—It is a fair copy of the *French* part of some of the manuscripts hereafter mentioned.

No. 3.

A SINGLE section quarto, entitled in *French:* "*La Chaka du Rik et de* "*Ezour Védam,*" in *Sanscrit* and *French.* Many passages are untranslated, a corresponding blank being left in the *French* page. "*Rik Béder Chaka*" is the *Sanscrit* title. It consists of dialogues between "POIPOLADO," as the teacher, and "NARODO," as the disciple. The subject of the first is the origin of evil. NARODO at the commencement says: "Vous avez dit en parlant de la creation que Dieu crea d'abord un "homme qui devait donner naissance au reste du genre humain, ce "premier homme n'estant qu'un, il n'avait par consequence qu'une figure "d'ou vient donc que ceux qui sont nés de lui sont de differentes figures "d'ou vient que les uns sont vertueux les autres pecheurs, voila que je ne "puis comprendre cette difficulté ne se trouve point dans le sisteme qui "j'ay suivi et que j'ay enseigné jusqu'ici."

THIS work is divided into four dialogues, each consisting of two chapters: in the former NARODO, who may be considered either as the *Indian Sishya,* or the *Christian Neophyte,* states the point of doctrine or the religious rite to be described, which in the latter, POIPOLADO, the *Indian Guru,* or *Christian* priest, confutes. The abstracts at the end of each second chapter will shew the subject of each dialogue:—the first is "iti risi dokino chake kormo prodonnio baronon, proton oullacho,"

(iti richi dacshina śáoé carma pradanya váranam prathama ullása*) rendered in French, "du rik chaka refutation du sentiment qui fait des œuvres "le principe de tout le bien et de tout le mal que nous eprouverons." 2d Dialogue; "iti risi pottimo chake adiatniko zogue kuondonon 2 oullacho," (iti richi paśchima śácé adyátmicayogè c'handanam ullása), "du risi "chaka refutation de la maniere proposé dans le chapitre precedent "pour parvenir par le moyen de la meditation a l'etre purement spirituel." 3d Dialogue: "iti risi autaro chake boichichiko serexte baronem 3 "oullacho," (iti richi uttara śácé vaiśéshaca śrishti varanam 3 ullása) "du risi chaka refutation de la prokrite et de la creation qu'on lui "attribue." 4th Dialogue: "iti risi purbo chake kalponiko diano baro- "nem 4 oullacho," (iti richi púrva śácé calpanica-dhyána varanam 4 ullása). The substance of this chapter is not stated in the French part, the Sanscrit means the refutation of the practice of meditation, proceeding from human invention, not divine authority.

THE "Zozur Béder Chaka," like the Ezour Védam, consists of colloquies between CHOUMONTO as teacher and BIACH as disciple, (See No. 1), the work consists of four parts, called bistaro, (vistara), which literally means a collection of words and may be rendered a division, chapter, or as in the French, a dialogue; the first relates to the Such'ápta Sadhana, the means of obtaining happiness by the worship of various objects con-

* ULLÁSA, means literally that which is pleasant, an entertainment, but here a division, chapter, or dialogue.

sidered sacred, such as the SÁLAGRÁMAM, &c. the second to the worship of GÁNÉSA, considered as the Supreme Being; the third relates to the notion that brutes possess knowledge ("connoissance") and are capable of virtue and vice like human beings, and to other points, which the author supposes to be connected with the *Hindu* doctrine of the transmigration of souls; and the fourth the mythological account of the several *Manus* and *Manwantaras*. Like the former, each dialogue is divided into two parts, containing the statement of the dogma and the refutation.

THIS manuscript contains, also, the title "*Chamo Béder Chaka*," but it is followed by one verse only, six blank leaves being left for this *Chaka*, which seems never to have been written.

THE hand writing of this manuscript differs from that in which the *Ezour Védam* is written, but agrees with that of the *Sáma Védam* and of all the others in which the *Sanscrit* and *French* are found together. The *Sanscrit* part of all these manuscripts contains many alterations and variations of reading in the same hand, either inserted in the margin or interlined; these sometimes correct, sometimes alter the sense and are such as an author only would make to an original work. A single example of this will perhaps be sufficient:—a line in the "*Chamo Bédo*," is thus written in the text—"pizoucho koloshon tioktua bicho bandon "zotipsoti" (piyúsha calasha tyectwà visha bhánḍam yedi'psati) and an asterisk over "pizoucho," refers to the word "omrito," which has the same meaning, in the margin, indicating that the author intended the line to be read "omrito koloshon," &c. and this substitution agrees with the

French, which is—"qui rejetterait un vase plain d'amrouton pour aller "s'ennivre de venain."

No. 4.

A SINGLE section quarto, rather less than the preceding, entitled "*Odorbo Béder Chaka*" in *Sanscrit* and *French*:—it consists of four dialogues between "OTRI" (ATRI) and "ONGIRA" (ANGIRAS) on the several subjects stated in the abstracts, appended to each and copied below. The translation of this work, thus commences. "ATRI: J'ay entendu de "votre bouche *L'Odorbo Védon* je voudrais bien encore apprende de "vous quelque expedient facile pour detruire et effacer les peches. J'en "appris un dans ce gout dans le temps que je demeurais dans le bonguo "dechan je vous en ferai part si vous me promettez de ne vous mettre en "colere." The words here underlined, occur again at the conclusion of the next speech of ATRI, when the following marginal note is referred to, "il est a l'est du *Benguale*;" this seems to corroborate the notion that these works were composed in *Bengal*.—The titles of the several dialogues in the *French* part are "de l'odorbo chaka refutation du "genre de penitence proposée dans le chapitre precedent."—The penance here alluded to, should rather be called an expiation, as it is the práyaschittam, prescribed in the *Dherma-Sástram*, for the slaughter of a cow, manslaughter, &c. "De l'ordorbo chaka refutation de la meditation "qui a pour objet et qui se termine au pronobo:"—"de l'odorbo "chacko refutation du genre de penitence appellée oto:"—"de l'odorbo "chako refutation du rentiment qui soutient que c'est la volonté qui est "purifié et du genre de penitence proposée pour cela."—At the end of

the manuscript, this remark is found: "ce livre et entre les mains de tous "les *Pouroitudu** c'est leur rituel."

No. 5.

THE "*Chama Védan*," noticed at the commencement of this paper, is on two sections foolscap and is endorsed "*Chama Védam*, 1er cajer" (Cahier). Besides this, there are other portions of this *Véda*, indorsed severally, "Du *Chama Védon*, 3me cajer" in one section:—"premier cayer de la supplement du *Chama Védam*" (in *Sanscrit*, "*Chamo Béder* "*Oupo Béd*") in one section: "3me 4me et 5me cajer de supplement du *Chamo Védam*" in four sections. The first of these is in *French* only, the others in *French* and *Sanscrit*. The first consists of dialogues between ZOIMENI and NARAION, respecting the *Panchangon* and the astrological notions of the *Hindus*, which it professes to refute. The several sections of the second, also, consist of dialogues between the same persons, but with a change of character, for here NARAION is made the teacher and ZOIMENI the disciple. The translation of that indorsed "premier cajer," commences thus: "ZOIMENI enchanté de la beauté du "*Védam* qu'il venait d'entendre et charmé tout a la fois de verités qui y "sont continées y prit gout et dans l'empressement d'en apprendre "d'avantage s'adresse de nouveau a NARAION et lui dit continuez "seigneur a m'instruire de la nature du premier etre et a me developer

* This word has the nominative masculine termination of the *Telugu* language: it means a domestic priest.

"ses grandeurs." The general subject is explained by this extract. The third section is the same in form as the preceding:—the *Sanscrit* abstract of the first chapter of that indorsed "3^me Cajer," is "iti "*Chomo Oupa Bede* adia, prokrite DURGÁ abotaro kotono pollabon" (iti *Sáma Upa Vede* ádya *Pracrïti* DURGÁ avatára cathana pallavam), which may be rendered, the section of the *Sama Upa Védam*, containing the account of the *Avatárams* of the goddess DURGÁ, considered as primæval nature; the whole relates to the several *Pracrïtis* and *Avatárams*, detailed by "ZOIMENI," and refuted by "NARAION;" the abstract of the last chapter ends with a speech of NARAION's, in answer to an account given by ZOIMENI, of the four-faced BRAHMÁ, of which the following is the commencement: "J'ay entendu tout ce que tu viens de dire au sujet de "BRAMMA a quatre visages, tout cela est une pure fiction, un pure mensonge "ecoute moi je vay t'en covaincre;"—and it concludes by denying* the divinity of BRAHMÁ, and asserting him to have been a man in all respects resembling other human beings.

CONNECTED with the last mentioned manuscripts is a single section, containing detached passages in *French* and *Sanscrit*, with many alterations and corrections; it appears to consist of original notes to facilitate the composition of the several parts of these works.

* An extract is hereafter given from this part of this manuscript, as a specimen of the *French* translation.

No. 6.

THE next manuscript to be noticed is one apparently older than any yet mentioned, though written in the same hand: it is on foolscap, bound in parchment and is much stained and worm-eaten: there is no general title, but the first leaf of the *French* is headed, "*Du Sandia*," and the abstract after one of the books mentioned is "De *Zozochi Kormo Béda*, des actions "propres des *Brames*, refutation du sandia de midi."—It professes, therefore, to be the *Carmacáńd'am* of the *Yejur Véda*, containing a refutation of the ceremonies observed in performing the *Sand'hya* at noon. This work contains an account of all the *Brahminical* ceremonies, as prescribed in the *Smrĭtis* and what the author calls, the "*Refutation*," of each; the interlocutors are, as in the other *Ezour Védam*, "BIACH," who gives the detail of the several ceremonies, and "CHOUMONTO," who refutes them.—Each book or chapter, as in most of the other manuscripts, is regularly divided into two parts, as here indicated; the account of the ceremonies and the refutation of them. The following is an extract from the 38[th] book: "38 Livre, du *Zozochi Kormo Bédo* de la maniere de "donner la vie aux idoles et de les animer;" being the commencement of the second part or refutation. "C. Tu viens de me faire part des "grandes ceremonies qui sert a animer un statue et a lui donner la vie, "tu a dit d'abord que les *Chouires* ne peuvent point faire cette ceremonie "et qu'ils doivent appeller un *Brame* pour la faire en leurs noms. Dieu "a crée les quatres castes pour pratiquer la vertu si c'est donc un act "du vertu de faire pareille chose pour quoi en sont ils exclus?" The last book, "42 livre," of this work ends thus: "Du *Zozochi Kormo*

" *Bédo* refutation de ce qui a esté dit au sujet des epreuves"—" iti
" *Zoz. Kor. Béd.* noro krite porikia barono bibeko—42 livre."

" Fin de *L'Ezour Védam.*"

" JESUS. MARIA. JOSEPH."

No. 7.

THE manuscript next to be noticed is in large quarto or small folio, bound in parchment:—it is written in the same hand as the rest, but fairer and has fewer corrections:—it is less damaged and apparently not so old as the one last noticed.—On the back of the first leaf, the title is thus written: " 1er Liv: *Rik Védam*,"* and the translation is headed " *Rik Béder Oupo Béd.*" This manuscript which is probably the largest of the whole, though it does not greatly exceed some of the others, contains eight sections of nine sheets each, or, 288 pages: each page contains about 56 lines of sixteen syllables each, being the half stanza of the *Anushtup* or *Slóca Vrittam*, and, consequently, the whole work consists of 16,128 lines or 8,064 stanzas. At the end of this manuscript are two dates on a slip of paper, on which the concluding lines of the translation are written, one is " Année 1732," the other " Année 1751." This work professes to be an *Upa Véda* of the *Rig Véda*, it commences as follows: " NARADO n'etant entierement point satisfait " de ce qu'il venait d'entendre au sujet de la creation chercha a proposer " de nouveau ses doutes a POIPOLADO et lui dit: N. J'ay entendu seig-

* THIS title, which is in the *Tamil* language and character, is correctly spelt, according to the orthography of that language *Iruccu Védam.*

"neur ce que vous venez de me dire au sujet de la creation mais je ne "suis point pleinement satisfait; ayez la bontè d'entendre a votre tour "ce que j'en say moi mesme et ce que j'en ay entendu dire—je viens "soumettre le tout a votre examen—je trouvray dans vos responses de "quoy achever de dissiper mes erreurs."—The abstract of the first chapter is: "Du *Rik Opo Bédo* du sisteme qui donne au monde la "figure d'une fleur et des grandeurs de la deesse TÁRÁ qui habite sur la "1^{ere} fueille a l'est." This chapter commences by stating, that "DURGA l'etre Supreme, l'etre eternal, a pris sous le nom de TÁRÁ une "figure humain et paroit soubs la figure de une femme pourque les "hommes puissent plus aisement fixer sur elle leurs imaginations et leurs "cœurs, elle qui crée qui conserve et qui detruit tout c'est elle aussi "qui soubs differents noms exerce la mesme puissance dans tous les "autres differentes pais. Le ministre qu'elle l'est choiseé pour commu-"niquer aux hommes ses ordres et pour conserver tout ce qu'elle a creé "est une oye ("*Oncho*," *Hamsa*), blanche d'une grandeur extraordi-"naire qui la transporte d'un lieu a un autre avec la meme rapidité "que le vent. Le principale occupation de cette oye est de celebrer "les grandeurs de la deesse et de dire incessament—Deepe qui avez "donné l'etre a BRAMMA, a ROUDRO, a INDRO, et qui avez creé toutes "choses pour quelle fin m'avez vous creé moy mesme dignez me don-"ner vos ordes et m'apprendre ma destinée." Then the work proceeds in a dialogue between the goddess and "*L'Oye*,"* in which the princi-

* THE word thus tranlated in the original, "*Oncho*," *Hamsa*, is either the swan or the phœnicopteros; in Southern *India* the former is usually represented as the vehicle of SARASWATÍ, and of the goddess TÁRÁ here mentioned (called, also the black SARASWATÍ), and at *Cási* the latter:—There are

pal part is borne by the former. She instructs her pupil in every thing relating to the arrangement of the universe which she thus describes: "La fleur qui composé le monde repondit la deesse est elle mesme com-" posé de dix feuilles je dois me metamorphoser sur chacune des ces "feuilles et y paroitre soubs differents figures tu auras la mesme sort et "tu instruiras les hommes des different vertus qu'ils doivent pratiquer et "quels sont les sacrifices qu'ils doivent m'offrir."—Then follows an account of the first leaf of the flower, which constitutes the first part of the chapter, which is succeeded by a refutation as in the former manuscripts: the abstract of the last part of the second chapter is, "*Rik* "*Opo Bédo* refutation de seconde feuille et des grandeurs de BIMA;" each of the ten leaves of the flower of the universe and the ten *Avatárams* of the goddess being described and refuted in a separate chapter.—The title of the second division of this work is the "*Rik Cormo Bédo*:" it is nearly the same in form and substance as the "*Zozoche Kormo Bédo*;" each chapter is divided, as in this work into a statement of the ceremonies and a refutation of them; it treats, first, on the several modes of performing penances or expiations ("des penitences pour les peches"), of daily ceremonies ("des actions jounalieres"); the morning, noon and

three distinctions of *Hamsa*, the *Rájá-Hamsa*, with a milk white body and deep red beak and legs, this is the phœnicopteros or flamingo: the *Mallicácsha-Hamsa*, with brownish beak and legs, and the *Dhártaráshtra-Hamsa*, with black beak and legs, the latter is the *European* swan, the former a variety.—The gait of an elegant woman is compared by the *Hindu* poets to the proud bearing of the swan in the water; SONNERAT, making a mistake similar to that in the text, translates a passage in which this allusion occurs in words to the following purport: her gait resembled that of the *Goose*. Other writers have fallen into the same error.

evening, *sandhya:* the festivals observed in the several months of the year, &c. &c.

No. 8.

IN five sections placed under the same cover as the foregoing, but not belonging to it, being written less closely and on older paper, is found another part of the "*Zozochi Kormo Bédo* :"—it is defective at the commencement and ends with the fifth book, "5 Livre." The abstract at the end of the first chapter it contains is—"Du *Zozocho Kormo* "*Bédo*, refutation de ce que se pratique dans le mois achino et en particu- "lier du sacrifice de DURGUA." It treats of the various sacrifices and offerings to DURGÁ, CÁLÍ, &c. &c.

HAVING afforded a general view of the contents of these manuscripts, I shall add a few conjectures, very imperfect certainly, as to their origin, and some remarks on the mode in which the forgery has been executed.—There prevails among the more respectable native *Christians* of *Pondicherry* an opinion, on what authority founded I know not, that these books were written by ROBERTUS DE NOBILIBUS:* this personage, of the *Society of Jesus*, and the founder of the *Madura* mission, long the most flourishing of any that ever existed in *India*, is well known both to

* ROBERTUS DE NOBILIBUS or ROBERT DE NOBILIS, a near relation of his holiness MARCELLUS the II. and the nephew of Cardinal BELLARMIN, founded the *Madura* mission about the year 1620. See note A.

Hindus and *Christians*, under the *Sanscrit* title of TATWA-BÓDHA SWAMI, as the author of many excellent works in *Tamil*, on polemical theology. In one of these, the *Átma-nirnaya-vivécam*, he combats the opinions of the various *Indian* sects on the nature of the soul, and exposes the fables with which the *Puránas* abound, relative to the state of future existence, and in an other, *Punerjenma Ácshépa*, he confutes the doctrine of the metempsychosis. Both these works, in style and substance greatly resemble the controversial part of the *Pseudo-Védas;* but these are open attacks on what the author considered false doctrines and superstitions and no attempt is made to veil their manifest tendency, or to insinuate the tenets they maintain, under a borrowed name or in an ambiguous form. The style adopted by ROBERTUS DE NOBILIBUS is remarkable for a profuse intermixture of *Sanscrit* terms; these to express doctrinal notions,* and abstract ideas, he compounds and recompounds with a facility of invention, that indicates an intimate knowledge of the language whence they are derived, and there can be no doubt, therefore, that he was fully qualified to be the author of those writings. If this should be the fact, considering the high character he bears among all acquainted with his name and the nature of his known works, I am inclined to attribute to him the composition only, not the forgery, of the *Pseudo-Védas.*† It

* He first translated in *Tamil* the prayers of the *Catholic* church as used by the *Christians* in the south of *India*, and all terms employed by them to convey ideas peculiar to the *Christian* faith are derived from him: they are found in BESCHI'S *Tamil-Latin Dictionary*, under reference to his authority.

† See note A. The passage quoted from MOSHEIM was pointed out to me after this paper was written. Which is juster, the character ROBERTUS DE NOBILIBUS bears in *India* for probity or that he appears to have obtained in *Europe* for fraud, is not for me to determine. I shall only remark, that it was long the fashion for *Protestant* writers to calumniate indiscriminately the *Jesuits*.

is not improbable that the *substance* of them as they now exist is from his pen, and that they consisted originally, like his works in *Tamil*, of detached treatises on various controversial points, and that some other hand has since arranged them in their present form, imposed on them a false title, transcribed them into the *Roman* character and translated them into *French*. To effect this would have been easy and would have required comparatively but little knowledge of the *Sanscrit*: the dissertations were probably divided by their author, as they now stand, into a statement of the points in controversy and a refutation of them; all that was necessary, therefore, was to prefix the prosaic introductions and to add the final abstracts containing the title given them, and they received at once the form they now bear. This supposition appears sufficient to account, for every appearance which they exhibit; it explains why the *Sanscrit* does not appear in its appropriate character and orthography, in which it is difficult to suppose it was not originally written by the author, and it also, explains (what I shall proceed to demonstrate), why the translation is not always a faithful version of the original.

The *Sanscrit* scholar will readily perceive, that the whole of the *French* translation of the extract from the "*Chamo Vedo*," is loose and defective, and this will, also, appear by a comparison of it with the *English* translation. In the 5th line of the invocation one of the epithets applied to the deity "*Okiorum (Acsharam)*," is rendered in the *French* "*Une* "*syllable compose son nom*," a version for which there is no foundation whatever; *Acsharà* it is true, as a noun substantive in the feminine gender, signifies a *letter*, but *Acshara-á-am*, as a noun of quality, and an epithet applied to the deity means, *the indestructible*, *the infinite*. The rest of the

version of this extract to the end of the invocation, bears but little resemblance to the original, as a comparison of the two last lines with the translation will sufficiently demonstrate.

Paréśa paramánanda śaranágata vatsala.

O high Lord! O pre-eminently happy, O merciful to those taking refuge with thee!

" Il est heureux et heureux par lui mesme, il est enfin le comble de
" toutes perfections et au dessus de toutes nos connoissances."

Tráhi mám carunâ sindhó muctidáya namastute.

Deliver me, O sea of mercy! for the sake of beatitude reverence to thee!

" C'est au dieu qui a pour ceux qui l'envoquent la tendresse d'un
" vray pere que j'offre mes adorations et mes hommages."

Though the turn given to the last may be conformable to *French* taste, it is scarcely possible that the translation of these verses could have proceeded from the pen of the author of the original.—The concluding sentence of this part of the translation " *Et c'est par la que je commence* " *le livre*," *&c.* is entirely wanting in the *Sanscrit*.

This comparison, however, though the selection of the passage on which it is founded was entirely fortuitous, certainly affords a less favorable idea of the manner in which the translation is executed, than in general it deserves: I subjoin, therefore, an extract from the " *Cham*

"*Oupa Bédo*," correcting the orthography of the *Sanscrit* and adding an interlined literal translation in *English*.

Brahmana iswara nityam n'ávatáraschá nischayah.

BRAHMÁ is not the eternal GOD and certainly not an incarnation of him.

Na srishti tasya jagatah cévalam nararúpacah.

Nor is he the creator of the world, he is merely a human being.

Yathá twam cha tathá sahi viśésha násti cinchana.

And as thou art, so is he, there is no difference whatsoever

Srishtin násampálanantu criyati sa swayam-prabhuh.*

Creation, destruction and preservation, these causes HE, the Self-ruling Lord.

Tasy'ávatára násty éva gunádisparsyanam tat'hà.

To him there is no incarnation, nor the contact of quality and the rest.

Na viváham striyah swargam cadáchit api vidyanté.

Nor are marriage, women or a peculiar heaven in any way known to him.

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* This ought, to preserve the sense exactly, to be *Caróti*, in the active, or *Cárayati*, the causal, or, to preserve the metre, *Curuté*, the medial form of *Crit*, Do; *Criyati* is the passive form and incorrectly, therefore, made to govern the accusatives in the sentence.

Yasmát bhrántim paretyajya Brahma áradhanam curu.
Therefore, quitting delusion, do reverence to the Supreme.

Anyet sevam swapna tulyam catham tasmin ratincharet.
All the rest is a dream, why place affection on it?

" LE BRAMMA a quartres visages n'est certainement pas le premier
" etre, il n'en est point une incarnation, ce n'est point lui qui a creé
" tout ce que nous voyons; il n'est qu'un homme, un homme comme toy
" et entre lui et toy il ne a nulle difference. C'est le premier etre qui
" seul a cree toutes choses c'est lui qui les conserve et les detruit a son
" gre mais cet estre ne s'est point encarné comme tu le dis; il ne s'est
" point uni aux goumalou; il n'a jamais eu de commerce avec les femmes,
" *c'est une impieté de dire et de le penser* quittez donc tout ce qui
" n'est que prestige et mensonge pour ne t'attacher que lui."†

IN the former part of this version the sense of the orginal is preserved with sufficient exactitude, but that of the three last lines is greatly obscured. Comparing this with the former extract, a generally correct notion may be formed of the mode in which the whole translation is executed, and, notwithstanding the identity I have noticed between the

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* Not in the original.

† The whole scope of these writings may be inferred from this extract: the intention is evidently to destroy the existing belief, without regarding consequences or caring whether a blank be substituted for it or not. To the doctrine here taught, as preparatory to a system of deism, nothing can be objected; but, after the teacher has succeeded in convincing his pupil that the deity never was incarnated, how is he to instruct him in the mysteries of the *Christian* faith?

hand writing, both of the *Sanscrit* and *French*, throughout the manuscripts, for those may be copies only, I think the judgement which will be formed will lead to the conclusion against the probability of the author and translator of these works having been the same person, and though the establishment of this point, will not prove the truth of the conjecture I have ventured to offer on their origin, it will corroborate any circumstances which may be hereafter discovered tending to establish it.

THE conclusion would be natural, that a person, who had acquired such an extensive command of the *Sanscrit* language as to be qualified to compose these works, and such a knowledge of the ceremonial observances and religious tenets of the *Hindus*, as to enable him to compile the materials of which they are formed, would have made himself acquainted, also, with the form and substance of the writings he was about to imitate, as essentially necessary to the success of his forgery: on the same principle, indeed, however different the motive, that a common swindler imitates, even to the minutest stroke, the signature of the person he intends to defraud. And, thus concluding, it might certainly be expected that these *Jesuitical* forgeries were nearly the same as the real *Vedas*; that they were the same in general arrangement, style of composition, as verse or prose, and in matter, as far as compatible with the intentions of the author: in none of these, however, do they bear to the writings, the title of which they assume, the most distant resemblance.

THE contents of the several *Vedas* and their general character are well explained by MR. COLEBROOKE, in his Dissertation "on the *Vedas*

"or Sacred Writings of the *Hindus*," in the eighth volume of the *Asiatic Researches*, and the veil in which ignorance had shrouded these writings has, therefore, been removed. More recently, translations of parts of them have been made;* but much remains still to be known, and the following observations on their arrangement, substance, and style of composition, if not possessing the recommendation of complete novelty, may perhaps be found to afford some addition to the knowledge we possess on a subject, which, until lately, was involved in impenetrable obscurity: they are here introduced to prove the assertion made in the preceding paragraph and to shew that in these particulars, the *Pseudo-Védas* differ, *toto cœlo*, from the genuine *Védas*.

THE four *Vedas*, including the *At'harvana* under that title, are each commonly divided into two parts: the *Purva-cándam*, the anterior division, also called *Carma-candam*, the division on works; and the *Uttara-candam*, the posterior division, also, called the *Jnyana* or *Brahma-candam*, the division on knowledge or on GOD. The former relates to *religious works*, appoints sacrifices and other ceremonies, and prescribes the mode in which they are to be performed. The latter relates *to spiritual knowledge*, teaches the being and nature of the godhead, of the soul, &c. The substance of each of these great divisions is technically arranged under three heads: First, *Vidhi*; *Precepts*, teaching in the *Purva-candam* the fruit to be expected from every rite, as

* The *Isávásyam*, with a translation, is appended to DR. CAREY'S *Sanscrit* Grammar, and of this and of the *Cénopanishad*, a version, after SANCARACHARYA'S Commentary, has been made by RAM MOHUN RAI, and published at *Calcutta*.

Swarga-cámah agnishtoman eyeyat. He who desires to obtain the heaven of the inferior deities, let him perform the sacrifice, called Agnishtóma, and in the *Uttara-candam*, the merit obtainable through meditation, by which the devotee approximates to a true knowledge of GOD, the nature of the soul, &c. as *Móc ha-cámah atmánam janiyat, He who desires eternal beatitude must understand the nature of spirit.* Secondly, *Mantram*; in the *Purva-candam*, this term includes *Prayers* and *Hymns*, addressed to various deities and appointed to be used at sacrifices and other religious rites, as that found both in the *Ric* and *Yejur Véda*, and used in the performance of the *Hómam*, or daily oblation of fire, beginning *Agni viswabhuc, &c. Fire who devourest the world, &c.* In the *Uttara-candam* it is applied both to *Hymns* and *Solemn Addresses* to the Supreme Being and *Didactic Explanations* of his nature and attributes, as that part of the *Taitiriyopanishat*, beginning *Brahma vijnyánam anantam satyam, &c.* The Supreme is *essential intelligence, infinity, truth, &c.* Thirdly, *Bráhmanam*;* this term, as applied to the *Púrva-candam*, embraces two distinct things;—it is given to *Precepts* declaring the mode in which religious rites are to be performed, thus: *Yedyamudhrit agni avastamiyát yejnyó násyet, If the fire be taken up when the sun has set, the sacrifice perishes*; or it is synonymous with the *Itihasa* or narratives found in this portion of the *Védas*; in the *Uttara-cándam*, it is also synonymous with the *Itihasa* and is applied to precepts teaching how a knowledge of the Supreme Being, the nature of the soul, &c. may be obtained, of which the following sentences

* *Mantram* and *Bráhmanam*, as collective terms, have a meaning different from these here assigned them, as explained in the following note.

from the *Taitiriy'opanishat* are instances, *Yávad bhédas távan'navéda. Inasmuch as he admits a difference* (between universal and individual spirit) *insomuch is he ignorant. N'áchááryam anupasadya Brahmavéda. The Supreme cannot be known without obtaining a teacher.*

IT follows from what has been said, that the whole *Véda* treats on two subjects only, *religion* and *devotion:* by *religion* I intend all that relates to external worship; by *devotion* all that relates to internal conviction. The ideas conveyed by the words I have thus rendered, *Carmam* and *Jnyánam*, correspond nearly with our theological terms: *works* and *faith*; the first literally means *work, act,* and *deed;* the second *knowledge;* but without knowledge true faith cannot exist, and from faith devotion immediately proceeds. The substance of the *Veda*, as divided into two portions* treating respectively on these subjects, may thus be recapitulated:—in the anterior portion, *on religion*, are contained precepts teaching the fruit obtainable from all religious rites, the prayers to be addressed to the various deities† presiding over them, and precepts teaching the mode in which they are to be performed:—in the posterior portion, *on devotion*, are contained precepts teaching the merit obtainable by devotion, addresses direct to the deity and explanations of his nature and attributes, and precepts, teaching how a knowledge of him

* The *Púrva-cándam*, consisting chiefly of hymns, is often termed *Mantram* generally, and so considered, is composed of the *Mantrams* of the four *Védas:* to each *Véda* is attached a number of treatises, termed *Upanishat* and distinguished by a variety of titles; the whole body of these, called, collectively, *Brahmanam*, constitute the *Uttara-cándam.*

† These as Mr. COLEBROOKE has clearly shewn, resolve themselves into *three*, [illegible] air and the sun and ultimately into *one*, the Supreme Spirit.

is to be obtained:—throughout both portions are scattered narratives of greater or less length, in the former generally, describing the origin of the rite, and in the latter often illustrating the power* of devotion by the example of some renowned devotee.

THIS slight indication of the contents of the real *Védas* must manifest, that *in substance* the *Pseudo-Védas* bear in general no resemblance to them. The address ascribed to JAIMINI by which the "*Chamo-Vedo*" opens is indeed nearly similar to a *Mantram* of the *Uttara-cándam* and many if not all the epithets therein applied to the Supreme Being are to be found both in the *Védas* and *Puránas*, from the latter of which they were borrowed. With the commencement, however, all resemblance ends; the contents of this *Pseudo-Véda*, as detailed in the abstracts of the several chapters, cannot be referred to any portion of the real *Véda*; they are neither *Vidhi*, *Mantram*, nor *Bráhmanam*, and belong not either to the *Purva* or *Uttara-cándam*.

THE distinctions chiefly to be noticed in the *arrangement* of the *Védas* are those called *Samhitá* and *Sáchá*. These terms, as usually applied, are nearly synonymous, both meaning an edition of the whole or a certain portion of one of the *Védas*: thus that edition of the *Crishna Yejush*, called *Taitiriyá* may be denominated *Taitiriyá-Sam-*

* The story of HARIS-CHANDA, in every respect, except it's *Indian* character, the same as that of JOB, which is told at length in the *Puránas*, and has been dramatized in *Sanscrit* and most of the spoken languages, is founded on an *Itahása* of the *Véda*. So is the fable of the *Nishada*, so well known to the *Tamil* scholar, by the beautiful paraphrase of it by the prince ADIVIRA RAMA PANDIYA, entitled *Naishdam*.

hitá or *Taitiríya-Sác,há*. But in fact, those terms are in their origin very different and properly describe very different things.

THE term *Sác,há*, literally means *a branch*, and is applied to the several branches of the same original, wherein, as in our editions of books, any new matter is introduced; for example the *Ád,hánam*, or rites observed in placing the sacrificial fires previously to the performance of any sacrifice, are stated in the *Paracya-Sac,ha* of the *Crishńa Yejush*, and not in the *Taitiríya-Sác,há*, the former containing besides many particulars in which the latter is deficient. Or a *Sác,há*, is a separate tract relating to some particular rite; thus in the *Sác,hás* of this *Véda*, the *Aswamédha-Sác,há* contains the ceremonies to be used at a sacrifice of a horse; the *Cat,ha-Sác,há*, those called *Chayanam*, performed, when the hearths are prepared for the sacrificial fires by paving them with lime-stones; and the *Aranya-Sác,há*, those prescribed for the *Árańacétucam*, wherein small earthen pots are used instead of lime-stones; it contains, also, the rules for teaching the *Véda* and to it is appended all the *Upanishats*, appertaining to the *Crishńa-Yejush*, which collectively constitute the *Uttara-cáńdam* of this *Véda*.

SAMHITÁ (the past participle derived from *Sand,há* the *d,h* being here changed by special rule for *h* before the formative affix *Ctapratyeyam*,) signifies literally *conjoined*, and is applied technically to the arrangement of the text of the *Véda*, into short sentences, regulated, when the style is verse, by the species of verse, and when prose, by the subject —Now whether the same portion of the *Véda* has been differently arranged by

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different persons, or whether it is subject to one unvarying mode of division alone, those who originally arranged it have each given their names to the result of their labors: thus, as the first *Sác'há* of the *Crishńa-Yejush* was arranged by the *Taitiríyah* or disciples of *Vaisampáyanah*, it is called the *Taitiríyá-Samhitá*, and of the five editions or tracts, composing the *Véda*, it is the only one usually so called, the others being more appropriately denominated *Sác'há* only, not being distinguished from each other by any peculiar arrangement of the text. From what has been said, it appears, that the term *Sác'há*, regards the substance of the writing to which it is applied, and *Samhitá*, the arrangement of the text.

BESIDES the term *Samhitá*, as applied to the arrangement of the text into distinct sentences, there are other minor divisions, the most usual of which are *Padam*, the simple division of the text into words in the order in which they stand, and *Cramam*, the division and re-combination of them according to the sense.—Again, the text is distributed into divisions larger than the *Samhitá*, as *C'hand'í*, *Súcta* and *Anurúca*, sections, of greater or less length, consisting of many *Samhitás*; *Ad'hyáya*, *Prasna*, *Prapatáca*, containing many sections: *Mańdala*, *Asht'aca*, or *Cáńda*, divisions or books composed of a certain number of chapters. These divisions are not common to all the *Védas*; some are confined to one only, as the *Chańda* to the *Śucla-Yejush*, and some are common to two or more, as *Súctam* to the *Rich*, and *At'harvana* and *Ad'hyáya* to all.

WITH the arrangement of the real *Véda* as here indicated, the *Pseudo-Védas* have little correspondence. The manuscript No. 6, is entitled "*Zozochi Kormo Bedo*," the *Carma-Véda* of the *Yejush*; this is the only allusion to the grand division of the *Véda* into two parts, and this is not correct, for the first part, is never called the *Carma-Véda*, but the *Carma Cánda* of the *Véda*. The titles of the MSS. No. 5 and No. 7, are equally erroneous; one is called the "*Chamo Oupa Bedo*" and the "*Rik Oupa Bedo*," confounding the *Véda* proper, with the *Angas* or dependant sciences necessary for the study of the *Véda*, called also, though improperly, *Upavédas*,* as grammar, astronomy, &c. The term *Sanhitá* is no where used; *Sáchá* is found in MSS. No. 3 and No. 4, which are called the *Sacha* of the *Rich*, &c. and this word is also used to designate the several dialogues they contain, the four first in the former, for instance, being called the East, West, North, and South *Sáchá* of the *Righ Vedam*. To this use of the word, the authors of the forgery have been led by its literal meaning: that it is never so applied in the real *Veda*, has been already shewn by the explanation given of its proper signification.—The other divisions found in this writing, such as *Ulasa* and *Vistára* in No. 3, *Pallavam* in No. 5, and *Virgo* in No. 6 and 7, are utterly unknown to the *Véda*.

THE form of these *Pseudo-Vedas* is constantly that of a dialogue between a teacher and his pupil: now though instances of this occur,

* THE *Upa Védas* properly so called are now lost, imperfect imitations of them only remaining: they were *Ayur-Veda*, the science of physic; *Dhanur-Véda*, the science of arms, and the *Gándherva Véda*, the science of music: these with the *Niti Sástra*, are, also, called *Chatur Vidyá*, the four sciences.

both in the *Mantrams*,* and *Upanishats*, they are far from frequent and altogether constitute a very small portion of either of the *Védas*; this form is however, of much more frequent occurrence in the *Puránams*; the *Bhágavat Gítá*, it is well known is, a dialogue between CRISHNA and ARJUNA; the whole of the *Bhárata* indeed is similarly arranged; so, also, is the *Bhágavatam*. In this, therefore, as in other circumstances, as will be shown, the *Jesuits*, unacquainted with the real arrangement of the *Védas*, have followed the *Puranams* to which they had easier access.—The interlocutors in these dialogues, are for the *Yejur Véda*, SUMANTA as teacher, VYÁSA as disciple; for the *Rig Véda*,† POIPALADO as teacher, NÁRADA as disciple; for the *Atharvana Véda*, ATRI as teacher, ANGIRAS as disciple, and for the *Sáma Véda*, JAIMINI and NÁRÁYANA, with a change of character, first one and then the other being teacher and disciple. In selecting these characters, a little knowledge is strangely intermixed with abundance of error; to make VYÁSA, who compiled and arranged the whole *Véda*, the disciple of SUMANTA, of whom he was in fact the preceptor is absurd; this awkward introduction of the chief of *Indian* sages, arises professedly from the composition of the *Puránas* being, also, attributed to him, the *Pseudo-Yajur Véda* being principally devoted to the refutation of the fables contained in those works. The *Yajur Véda*, as is well known is of two descriptions, the *Crishńa* or black *yejush*, originally taught by VAISAMPÁYANA, and

* THE former and latter divisions of the *Véda*, under these general titles, as explained in a former note.

† THE usual arrangement of the titles of the *Védas*, are *Rig*, *Yejur*, *Sáma*, *Atharvaņa*; I here mention them as casually numbered in the preceding account of the MSS.

the *Śucla* or white *Yejush* revealed to YÁJNYAVALCYA by SU'RYA: these distinctions are overlooked by the *Jesuits*.

NÁRADA, the disciple in the *Pseudo-Rig Véda*, is actually introduced in this character in the *Upanishats* of the real *Véda*, but there is great difficulty in identifying the other personage, POILAPADO; the original teacher of this *Véda* was PAILA, and the *Jesuits* may have added by mistake the two last syllables to his name; it is worthy of notice, however, that one of the *Śác'hás* of the *At'harvana Véda* is called PAIPPALAD'HII, from the name of its author, which they may have supposed to be PAIPPALÁDA, though in truth, it is PIPPALÁDA: no part of the *Rig-Véda* is, however, attributed to this sage.

VARIOUS parts of the *Hindu* scriptures are attributed to various sages; among others, ANGIRAS is an interlocutor in some of the dialogues of the *Upanishats*, and, though I cannot advert to any particular instance, ATRI may, also, be found in this character; neither of these, however, are stated as the teacher of the *At'harvana Véda*; the person who is said to have received it directly from VYÁSA is SUMANTA, as already noticed.

WITH respect to the *Sáma-Véda*, the forgers are more correct, JAIMINI is considered the primitive teacher of this *Véda*, but who is intended by NARÁYANA, is not so clear; they cannot mean VISHNU under that title, and I know of no sage of this name mentioned in the *Vedas*, or as being connected with them. The change of character these two personages

undergo, is remarkable, but I think it may be explained; in fact JAIMINI is considered by the *Hindus* as the founder of what is called the *Púrva Mimámsicá* school, who teach, that the *Carman*, *works or rites*, are the essential part of religion, and that the power of the divinity is innately embodied in the words of the uncreated and eternal *Véda*;* those to whom these writings owe their present form, seem to have discovered this, probably from the information of some of their native assistants, while in the act of arranging their materials, and, struck with the absurdity of attributing to this personage doctrines so opposite to those he was known to have maintained, to have deposed him from his dignity of teacher and raised to it his *quondam* disciple.

If the *Pseudo-Védas* differ entirely from the real in *substance* and *arrangement*, the difference they exhibit in *style*, also, is not less remarkable. The *Sáma-Véda* is called the *Metric*, and the *Yejush*, the *Prosaic-Véda*, but in the latter, verse is occasionally intermixed with the prose. The *Mantrams* of the *Sáma-Véda*, when used in sacred rites, are sung; those of the other three are chaunted, and in the written copies, therefore, the accents are marked as in modern editions of *Greek* works, or as in the service books of choirs. The *Rig-Véda* is wholly in verse and the *Atharvana* partly in verse and partly in prose. Three species of verse are generally used in the *Véda*, with which others are occasionally, but

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* SOME sects of the *Jews* held with respect to the bible, and some sects of *Mahommedans* now hold with respect to the *Koran*, nearly the same opinion: this particular folly does not appear to have ever infected any denomination of *Christians*.

not frequently, intermixed. The first the *Anushtubh Vrittam*, consisting of a stanza of four lines, each containing eight syllables, but generally written in two long lines of sixteen, resembles in this respect, the common *Slóca Vrittam*, which, also, belongs to the *Anush'tup Chhandas*; but, though according in outward form, they are very different in construction and metre. This I shall proceed particularly to demonstrate, for in the latter species of verse, seldom, if ever used in the *Védas*, all the *Furánas*, the *Bhárata*, *Rámáyana*, and other long poems, are chiefly written, and in this metre, also, as will be presently shown, the whole of the *Pseudo-Védas*, a few introductory passages and abstracts of chapters, which are in prose, excepted, are composed.

THE possible variation of the species of verse included under the term *Anush'tup Chhandas*, or of the combination of long and short, in a line of eight syllables, is two hundred and fifty-six; but, as every species used, must end in a long syllable, and the last of every verse is, according to the rules of prosody, common, this number is virtually reduced to one hundred and twenty-eight. The *Slóca Vrittam*,* as from the frequency of its use it is especially denominated, is restricted in the respective verses to certain species of the *Anush'tup Chhandas*. The first, which is the same in each stanza as the third verse, may take thirty-two different species, but many of these are of very unfrequent occurrence; the second, the same as the fourth verse, can take only ten. The species,

* THE first term, *Slóca*, *signifies a quatrain* in any measure, and *Vrittam*, *verse*, but thus compounded, the particular stanza, the rules for which are here stated.

however, which most frequently occur in the first verse are those numbered, in the general scheme of the *Chhandas*, from seventeen to twenty-two, and from twenty-five to thirty, inclusive, each of which end in three long preceded by one short syllable; those belonging to the second verse, are those numbered from eighty-one to eighty-four and from eighty-nine to ninety-four, inclusive, ending in a short between two long syllables, preceded by a short syllable. The rule, therefore, for the composition of the *Śló́ca Vrittam*, liable to such exceptions as may be caused by the occasional appearance of the other species admissible into the first line, may thus be stated: the three first syllables of every verse are common, excepting, that a long syllable must be found either in the second or third place; the fifth syllable in each line must be short; the three last syllables of the first and third verse must be long; and the second and fourth must conclude with a short between two long syllables.

THE *Anushtubh Vrittam*, of the *Véda*, is not restricted to any species of the *Chhandas*, but provided the iambic measure, allowing nevertheless of a very free intermixture of trochees, pyrrics and spondees, is preserved, may be used. It is necessary, however, that the iambic structure should be more carefully maintained in the second and fourth, than in the first and third lines, and in this respect the rythm of this stanza is distinguished in a very marked manner from that of the *Śló́ca Vrittam*: the whole number of species which ends in two iambics are sixteen, ranking in the general scheme of the *Chhandas* from eighty-one to ninety-six inclusive, of which four are rejected from the second line of the *Śló́ca*

Vrittam on account of short syllables, occuring in the second and third places, and two, numbered eight-five and eighty, the first consisting of a spondee followed by three iambics, and the second wholly of the latter feet, on account of the entire prevalence in them of the iambic rhythm, for which reason, they are preferred in the *Anushtub Vrittam* of the *Véda*, and occur in every line more frequently than any other species.*

OF the other two species of verse, the *Trishtup Vrittam* is almost peculiar to the *Védam* being seldom found in other works, and the *Gáyatriyam* is entirely so. The *Trishtup* stanza consists of four verses, the measure of which is dactylic, being formed by adding a long and two short syllables to any of the six species of *Anushtup Chhandas*, numbered in the original scheme from one hundred and thirteen to one hundred and eighteen: other variations occasionally occur, but the rhythm of this stanza is much more limited than that of the *Anushtup* or the *Gayatriyam*. The *Gáyatriyam*, so called from the most holy of texts, the *Gayatrí*, being written in this measure, is a stanza of three lines, each containing eight syllables, but it is usually divided into a long line of sixteen and a short one of eight, and should contain, therefore, twenty-four syllables, though frequently, as in the *Gayatrí* itself, it falls short by one of this number. The rhythm of the *Gáyatriya* does not differ from that of the *Anushtub Vrittam*.

* IT follows from what is here said; that the prevalent measure of the *Védas* is nearly the same as *English* blank verse, or, regarding, also, the length of the line, exactly that, formerly confined to lyrical composition, but considered by modern poets as not unworthy of the epic muse. As the composition of the *Véda* must unquestionably be referred to a very early period of antiquity, the iambic metre ought, probably, to be considered as the first step in the invention of measured language.

THE *Pseudo Vedas* are entirely written in the stanza called *Slóca Vrittam*, each being divided into two lines of sixteen syllables, but following exactly the rule I have given for the composition of this species of verse; the following extract from the commencement of the first "*Bibeko*" of the "*Rik Bedo Oupa Bedo*," the *French* translation of which has been already given, in which the commencement of each verse is marked by a capital letter and the measure indicated by the usual prosodial marks,* will exemplify this.

Tārā rūpā mahā Dūrgā—Nityă brāhmă swănăthĭnī,
Lōcānām dhyānăyōg'ărhām—Mūrtī rūpām prătish'tătī,
Tăsyāh sĕrvām jăgăt srĭsh'tām—Pālyām năsyānchā nisĉhăyām,
Evām dăsă săprătyēcshām—Dăsă rūpām vĭbhărtīsā,
Ajnyāyā cŭrŭtē nĭtyām—Srishtădĭ pālănādĭcām,
Tătră hāmsă sŭrūpāschā—Sūclā vĕrnā bhărēt băhū,
Yēt pācsha cshēpănăd vāyaū—Gămăn' āgămănam chărēt,
Să hāmsās stŭyătē† dēvīm—Cŭtrătyā să nyăsāmăyēt,
Bhărătī brāhmărŭdrānām—Indrādīnām chă sĕrvăsăh,
Cărănām twām măhā dēvī—Mămămărthăm săsărjĭthā.

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* THE rules for the quantity of syllables in *Sanscrit* are minutely the same as in *Latin;* when therefore, in the following extracts the long mark is placed over a pure vowel, it is long by nature, and when over one preceding a double or compound consonant, it is long by position.

† THIS is a mistake similar to the one already noticed, as *Stŭyatè* is the passive form of *stu*, *praise;* it ought to be *Stauti* or *Stute.* In the first verse of the last stanza of this quotation PANINI's head is again broken; *Brahmarudrănăm* in the plural is used instead of the dual *Brahma-rudrau.* These errors are probably intentional, as the genuine *Véda* is often ungrammatical; never, however, in such a degree as to use the passive for the active voice, though the plural is often substituted for the dual number.

FROM this specimen it will be seen that according to the rule laid down, the fifth place in each verse is short, and that in the three last places of the alternate verses are three long and a short between two long syllables. That this is the appropriate measure of the *Puránams*, *B,háratam*, *Bhágavatam*, &c. the following extract will prove:

THE first stanzás of the *Śconda Purána* in the *Slóca Vrittam*, immediately following the invocation.

Cădăchīn Nārădă srīmān—Snătwă sri Nārmădāmbhăsi
Srīmăd ŏncārăm ābhyărchă—Sēnădām sērvădēhĭnă,
Vrăjăn vĭlocăyămchăcrē—Pŭrŏ Vĭndhyăm dhărădhărăm,
Sāmsără-tăpă sămhārī—Rēvă vărĭ părĭshcrĭtăm,
Dwăirŭpēn ăpĭ cŭrwăntăm—Stăvărēnă chărēnăchă,
Swăbhăchyēnă yēdh' ărthh'ăchyăm—Uchchăir văsŭmătĭm ĭmăm,
Răsălăyăm răsălăĭs tăĭs—Asŏcăis sŏcăhărĭnăm,
Tălăis tămălăis hĭntălăis—Sălaĭs sērvătră sălĭtăm.

THE first stanzas in *Slóca Vrittam* of the *B,háratam.*

Sămăsīnăm ăb,hyăgăchchăt—Brăhmărshĭn săm'sĭtă vrătăn,*
Vĭnăyă vănătŏ b,hŭtwă—Cădăchĭt sŭtă năndănăh,
Tăm ăsrămăm ănŭprăptăm—Năimĭs'ărănyă văsĭnăm,
Chĭtră 'srŏtŭm căt,has tătră—Părĭvăvrus sămăntătăh.

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* THIS is an instance of the introduction of an universal species into the first verse.

THE first stanzas in *Śloca Vrittam* of the *Bhágavatam.*

'OM.

Naimīshē 'nimīshā cshētrē—Rishāyāh 'saūnăc' ādāyāh,
Sāttrām swārgāyā locāyā—Sāhāsrām sāmām āsātā,
Tāēcādā tū mānāyā—Prātār hūtā hūt'āgnāyāh,*
Sātcrī,tām sūtām ā'sīnām—Pāprāchch,hōr idam ādārāt.

FINALLY to demonstrate that the works which I have designated by the term *Pseudo-Védas*, deserve that name, all that is now necessary is to make a few extracts from the genuine *Védas*, sufficient to shew their general style, and in what it differs from that of the *Puránas* and of these manuscripts. In doing this I shall, to prove that the remarks I have made on this subject are correct, state minutely the arrangement, subdivision, and style of a portion of the *Védas*, and that which has been selected for the purpose, and which is now before me, is the collection of hymns belonging to the *Rig Védam* called *Pavamánam.*

THE *Mantras* of the *Pavamána Súctam*,† or collection of hymns to the god of the winds, are recited at the commencement of the *Agnishtoma*, or primary sacrifice, which must be performed before any other rite of this description can be undertaken.—This collection consists of

* THIS is another instance of the occurrence of an unusual species in the first line.

† *SÚCTAM*, which may be translated hymn, like *Mantram*, *Brámanam*, &c. varies in its use: it is applied to the whole of the *Pavamánam*, to each of the chapters, and to one or a number of consecutive *Ch,handas* relating to one subject.

four *Adhyáya* or chapters, the first containing twenty-four, the second thirty-three, the third forty-one, the fourth twenty-two *Chańdas* or sections. Nearly the whole of the *Súctam*, is written in the *Gáyatriya* metre, *Anushtup* stanzas being sparingly intermixed; part of the 18th, and the whole of the three concluding *Chańdas* of the fourth *Adhyáya* have *Anushtup* and *Trishtup* stanzas intermixed. Each *Chańda* consists more frequently of four, five or six stanzas, less frequently of seven and eight, which number is seldom exceeded. When the measure changes from the *Anushtup* to the *Gáyatriya* metre, a short verse of eight syllables, like that which with the latter closes, is interposed. The three verses of the *Gáyatriya* ought to be *Anushtup* of eight syllables, but it is a licence not unfrequently assumed to drop one, or even two syllables when compound consonants such as *dra*, *bhya*, or *csha* occur in the line, thus reducing the number to seven, or six syllables. These remarks are exemplified by the following extracts:—in the original the verses are only separated by two short perpendicular lines thus (||), I have arranged them after the manner of *European* verse that the metre may be more distinctly shewn.

THE first *Chańda* of the first *Adhyáya* of the *Pavamánam*, consisting wholly of *Gáyatriya* stanzas:

Śrī Gańéśáya namah || *Harih 'Om*, ||

Swădīshtăyā mădīshtăyī—Păvāsyă sāmădhārăyā,

Īndrāyă pātăvē sŭtāh,

...shāhă vīśwă chācshănīr—Abhĭyōnĭmăyō hătām,

Drŭnasădāsthăm āsădāt,

O

Vārīvō d,hātāmō b,hāvā—Māhīsh'tō vrītrāhāntāmāh,
Pārshārād,hō māg,hānām,
Āb,hyārshā māhānām—Dēvānām vitimam d,hīsā,
Āb,hivājām ūtārsrāvāh,
Twām āch,hūn chārāmāsī—Tādīd ārt,hām d,ivēdīvē,
Īndōtwēnā āśāsāh.

The sixteenth *C,hańda* of the fourth chapter of the *Pavamánam*, consisting of *Anushtup* and *Gáyatriya* stanzas intermixed:

Pāvāsyā sōmūm āndāyānn—Īndrayā mād,hūmāttāmāh,
Āsrīgrām dēvā vīlāy'ē—V'ājāyāntō rāt,hā īvā,
Tēscātā sōmā dīntāmāś—Cātcā vāyūm āsrīcshātā,
Grāvnātūm nō āb,hīsh'tūtāh—Pāvīttrām sōmā gāchchāsī,
Dād,hāh stōttēsū vīryām,
Ēshātūm nō āb,hīsh'tūtāh—Pāvīttrām āīgāhātī,
Rāc̄shōk'āvārām ānyāyām.

A comparison of these extracts with those from the *Puránas* and *Pseudo-Védas*, will shew, that in the former, the proper measure, according to the rule laid down for the *Anushtub Vrïttam* of the *Véda*, is every where preserved and that this differs essentially from the measure of the *Puranas*, with which that of the *Pseudo-Védas* exactly corresponds; the only difference being, that the general rule for the composition of the *Ślóca-Vrïttam* is more uniformly followed in the latter, than in the former.

In these observations on the style of the genuine *Védas* compared with that of the *Puranas* and *Pseudo-Védas*, I have confined myself to the

outward form, the variation in which is apparent on inspection only, even to those unacquainted with the language. A disquisition on the peculiarities of the style, which distinguish the language of the *Véda* from that of the *Smrïtis* and of the *Puránams* and heroic poems, and from the classical *Sanscrit*, as finally polished by the authors of the *Cávyams* and *Nátacams*, would not have added to the evidence adduced to prove the nature of the writings, of which I have treated in this paper, whilst it would be intelligible only to the *Sanscrit* scholar. It is sufficient to say, without producing further proof than the authority of Sir W. JONES and Mr. COLEBROOKE, (see preface to the Institutes of MENU and Dissertations on the Religious Ceremonies and Sacred Writings of the *Hindus*, Vols. 7th and 8th of the *Asiatic Researches*,) that the *Sanscrit* of the *Véda* is materially different from that of all other *Hindu* compositions; that, as having a peculiar grammar, taught as one of the *Angams*, or subordinate *bodies* of the sacred writings, it must be considered a distinct dialect; and as such can never be confounded with the language of the *Puránams*, the style of which the authors of these forgeries have imitated, it must be confessed, with wonderful ingenuity and success.

NOTE A.

THE manuscripts described in the preceding essay, which as I have already stated, are in possession of the *Catholic Missionaries* at *Pondicherry* were discovered, as it may justly be said, for the knowledge of their existence was previously confined to a few individuals belonging to the mission, by Sir ALEXANDER JOHNSON, the chief justice on the island of *Ceylon*, and Captain FRASER, the *British* resident at *Pondicherry*, during a visit of the former gentleman to the coast. It was from Sir ALEXANDER JOHNSON, also, that I received the printed copy of the *Ezour Védam*, and the information which induced me to make the inquiries respecting these manuscripts, the result of which I have here stated.

NOTE B.

ROBERTUS DE NOBILIBUS, or ROBERT DE NOBILI, was the founder of the *Madura* mission, sometime about the year 1620; this appears from the following extract from the letter of P. PIERRE MARTIN, being the first of Collection V. of the *Lettres Edifiantes*. Speaking of P. EMMANUEL LOPEZ, who had charge of a congregation of *Christians** in *Travancore* he says: "Il y a plus de cinquante ans que ce "missionaire travaille avec un zéle indefatigable au salut des *Malabares*. Il est le dernier *Jesuite*, qui "ait paru dans le *Maduré* avec l'habit que nous portons en *Europe*. Car quoiqu'il y ait plus de quatre- "vingts ans, (this letter is dated the 1st June, 1700), que le pere ROBERT DE NOBILIBUS fonda cette "fameuse mission sur le pied qu'elle est aujourd'hui, c'est a dire, en s'accommodant aux coûtumes du "pays, soit pour l'habit, la nourriture et la demeure, soit pour les autres usages, qui ne sont point con- "traires á la Foi et aux bonnes mœurs; cependant, les *Portugais* ne parent se resoudre a ne plus paroitre "en ces terres en habit *Européen*, qu' apres avoir été convaincus par une longue experience que cette con- "duite etoit tres préjudiciable á la religion, et á la propagation de la Foi, par l'aversion et le mépris que "ces peuples ont conçû contre les *Européens*."† His birth and family are stated in this letter in these words. "Le Pere ROBERT DE NOBILIBUS illustre par sa naissance, étant proche parent du Pope MARCEL "II, et neveu propre du Cardinal BELLARMIN, (the Cardinal's mother, CYNTHIA CERVINI was sister to "Pope MARCELLUS II. See the article BELLARMIN in BAYLE), mais plus illustre encore par son esprit, "par son courage, et par le zéle des ames dont il bruloit, fut le premier qui, au commencement du siecle passé, "mit en usage le moyen dont je viens de parler," &c. The writings of ROBERTUS DE NOBILIBUS in the *Tamil* language were it seems studied by all who entered the *Madura* mission; P. PIERRE MARTIN, speaking of certain *French* missionaries being sent to this misson, thus mentions them. "Pour‡ reussir dans "une enterprise si glorieuse a dieu et si avantageuse a l'eglise, il etoit nécessaire d'envoyer quelques uns "de nos Peres FRANCOIS dans cette ancienne mission, ou ils se pressent apprendre la langue, s'instruire des "coutumes et des usages de ces peuples, former des catechistes, lire et transcrire le livres que le venerable "Pere ROBERT DE NOBILIBUS et nos autres Peres out composés," &c. The nature of these works I have stated in the text and, as there asserted, in none of them is any attempt made to conceal their origin or intention; no false title is assumed, but the attack is open and avowedly directed by the *Christian* teacher against the errors of *Heathenism*.—It is certain, however, that the mission of *Madura* was founded on the principle of concealing from the natives, the country of the missionaries, and imposing them on the people as belonging to the sacred tribe of the *Bráhmans*, (*Rómaca Bráhmana* was the title assumed) and this deception, probably, led to many more; at least ROBERTUS DE NOBILIBUS is accused by MOSHEIM in his Ecclesiastical History both of fraud and perjury in his endeavours to support his assumed character. The passage in which he is mentioned and the note in which the charge is made, I quote at length.

"THESE missionaries of the court of *Rome*,¶ spread the fame of the *Christian* religion through the "greatest part of *Asia* during this century. To begin with *India*; it is observable, that the ministerial "labours of the *Jesuits*, *Theatins*, and *Augustinians* contributed to introduce some trace of divine truth, "mixed, indeed, with much darkness and superstition, into those parts of that vast region, that had "been possessed by the *Portuguese* before their expulsion from thence by the *Dutch*. But of all the "missions that were established in these distant parts of the globe, none has been more constantly and

* Page 14 vol. 5. † Page 19, vol. 5. ‡ Page 3, vol. 5. ¶ See Mosheim Ecc. Hist. vol. 4, page 211.

"universally applauded than that of *Madura*, and none is said to have produced more abundant and "permanent fruit. It was undertaken and executed by ROBERT DE NOBLE,* an *Italian Jesuit*, who "took a very singular method of rendering his ministry successful. Considering, on the one hand, that "the *Indians* beheld with an eye of prejudice and aversion all the *Europeans*, and on the other, that "they held in the highest veneration the order of *Brachmans* as descended from the gods; and that, "impatient of other rulers, they paid an implicit and unlimited obedience to them alone, he assumed "the appearance and title of a *Brachman*, that had come from a far country, and by besmearing his "countenance and imitating that most austere and painful method of living that the *Sancanes* † or "penitents observe, he at length persuaded the credulous people that he was in reality a member of "that venerable order.‡ By this stratagem, he gained over to *Christianity* twelve eminent *Brachmans*, "whose example and influence engaged a prodigious number of the people to hear the instructions, and "to receive the doctrine of the famous *Missionary*. On the death of ROBERT, this singular mission was "for some time at a stand, and seemed even to be neglected. But it was afterwards renewed, by the "zeal and industry of the *Portuguese Jesuits*, and is still carried on by several *Missionaries* of that "order from *France* and *Portugal*, who have inured themselves to the terrible austerities that were "practised by ROBERT, and that are thus become, as it were the appendages of that mission. These "fictitious *Brachmans*, who boldly deny their being *Europeans* or *Franks*, and only give themselves "out for inhabitants of the northern regions, are said to have converted a prodigious number of *Indians* "to *Christianity*; and, if common report may be trusted to, the congregations they have already "founded in those countries grow large and more numerous from year to year. Nor indeed, do these "accounts appear, in the main, unworthy of credit, though we must not be too ready to receive, as "authentic and well attested, the relations that have been given of the intolerable hardships and sufferings "that have been sustained by these *Jesuit-Brachmans* in the cause of CHRIST. Many imagine, and not

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* OTHERS call this famous missionary ROBERT DE NOBILIBUS.

† SHOULD be *Sanyásis*.

‡ URBAN Cerri, Etat present de l'Eglise Romaine Page, 173.

☞ NOBILI, who was looked upon by the *Jesuits* as the chief apostle of the *Indians* after FRANÇOIS XAVIER took incredible pains to acquire a knowledge of the religion, customs, and language of *Madura*, sufficient for the purposes of his ministry. But this was not all: for to stop the mouths of his opposers and particularly of those who treated his character of *Brachman* as an imposture, he produced an old, dirty parchment in which he had forged, in the ancient *Indian* characters a deed, shewing that the *Brachmans* of *Rome* were of much older date than those of *India* and that the *Jesuits* of *Rome* descended, in a direct line from the god BRA'MA. Nay, Father JOUVENCE a learned *Jesuit*, tells us, in the history of his order, something yet more remarkable; even that ROBERT DE NOBILI, when the authenticity of his smoky parchment was called in question by some *Indian* unbelievers, declared, upon oath, before the assembly of the *Brachmans* of *Madura*, that he (NOBILI) derived really and truly his origin from the god BRA'MA. Is it not astonishing that this Reverend Father should acknowledge, is it not monstrous that he should applaud as a piece of pious ingenuity this detestable instance of perjury and fraud?

SEE Jouvency Histoire des *Jesuits*.

NORBERT Memoires Historiques sur les *Missions* de *Malab.* tom. II. Page, 145.

"without good foundation, that their austerities are, generally speaking, more dreadful in appearance "than in reality; and that, while they outwardly affect an extraordinary degree of self-denial, they "indulge themselves privately, in a free and even luxurious use of the creatures, have their tables "delicately served, and their cellars exquisitely furnished, in order to refresh themselves after "their labors."

THE following is an extract from a history of the *Jesuits* procured at *Pondicherry*. I have not seen the work whence it was taken; but as the idea it conveys of the dress and appearance of the members of that society, when attached to the *Madura* mission, coincides with the preceding accounts and with all other testimony respecting them, no doubt can be entertained of its accuracy. The work, whence it is taken, contains a representation of a missionary in his *Indian* habit; probably the same as is stated in the following translation to have been taken of ROBERT NOBILI himself:

"NOMEN & originem traxit hæc missio ab urbe *Madurè*, *Regni* apud *Indos* sic dicti, primaria. "Initium illi dedit P. ROBERTUS DE NOBILIBUS societatis JESU et MARCELLI II nepos, zelo "Apostolico nobilissimus. Ille, ut Brachmanes ad Christianam fidem adduceret, Europeum homi- "nem exuit, Indigenarum assumpto vestitu, et vivendi consuetudine, ac primo Rajas, qui apud "*Indos* sunt in pretio, cultu exteriore imitatur, sed frustrà. Brachmanes sœculares deinde imitatus "eorum more se vestit, funiculum ex *Gossipio* triplicatum ab humeris honoris tesseram detulit, & in "omnibus integrum Brachmanem sese effinxit; at conversionem nunquam, sed solam eorum familiari- "tatem obtinuit: spem tamen non abjecit ROBERTUS, novam metamorphosim adinvenit & a sæculari. "Brachmanorum habitu, ad Religiosum transiens, more Saniassi pœnitentis induitur. Est enim Saniassi "magna apud Brachmanes æstimatio, utpote legis magistri, vitam profitentes a voluptatibus alienam, "per diem unicâ orizæ comestione contentam. Hanc professus vitam ROBERTUS multos Brachmanes "Christo adjunxit. Hæ piæ ROBERTI industriæ multas sensère impugnationes, videbantur enim aliquid "involvere superstitiosum, sed eas evicit ROBERTUS, et illis adhuc utuntur in eo regno Societatis *Jesu* "operarii. Habitum imago representat è Gossipina tela confectum colore in rubrum inclinanti. "Illum sine ullâ subuculâ gerunt. Nudis pedibus ut plurimum omninò incedunt, aliquando soccos "duobus digitis apprehensos adhibent, capillos in nodum suprà verticem capitis colligunt, quos fascia "gossipina plures circumdant & contegunt."

I SHALL close this note by the translation of a passage from a work entitled, "*Tiru-sabeiyin Charitra Postagam*," or "*Historia Ecclesiastica*," written in *Tamul* and published by the *Protestant Missionaries*, at *Tranquebar* in 1799. This passage is from the section relative to the transactions of the *Missionaries* in *India*, from the arrival of the *Portuguese*, at page 238 of the work, and under the year 1607. The work therein alluded, as having been written in 1729, is by the famous *Jesuit Missionary* CONSTANTIO JOSEPHO BESCHI, known throughout the South of *India*, for many valuable compositions in the high dialect of the *Tamul*, under the title of the *Vira-Mâmuni* and *Dhairya-Nât,ha Swâmi*. This extract is from the preface to the *Vêda Vilaccam the Elucidation of the Scriptures*, written professedly against the heretics of *Tranquebar*.

TRANSLATION.

[1607.] AT that time ROBERT NOBILI, called TATWA-BÔDHAGER, clothing himself in the habit of a *Sanyâsi*, endeavoured to promulgate *Christianity* in this country. The secretary to the congregation

de Propagandâ Fide, wrote in 1676 to Pope INNOCENT, that ROBERT NOBILI, although he called himself a Bráhman, was not guilty of falsehood.* He is represented with this habit and appearance in a picture in the convent of the paulists at Rome, under which is the following inscription,'—"Father "ROBERT NOBILI, a paulist of the city of Rome, and of an illustrious family; a godly and learned "personage, who laboured to convert the heathens 45 years, eating nothing but rice and vegetables, "and died happily at Mayilapùr (St. Thomè near Madras) on the 16th January, 1656."—'That which was written at Yélàcúrchi, (the principal residence of BESCHI') in 1729 in his praise is as follows:—"As the resplendent sun runneth his course in the firmament, but alloweth not his radiant face "to be seen, so although St. THOMAS, one of the twelve disciples of our LORD JESUS, and St. XAVIER, "far renowned for innumerable miracles, entered and preached the gospel throughout this country yet "for a long time the darkness thereof was not dissipated. At last, as if the obscurity of the night, "that elsewhere lowereth over all, had been dispelled by the rising of the sun, it pleased our Lord to "turn his gracious eyes towards this country covered by paganism as by a cloud, and one hundred and "twelve years past, to send hither orthodox priests to enlighten all souls. TATWA-BÓDHACA SWA'MI who "then appeared steadfast in austere devotion, confirmed in the true faith, and perfect in virtue, was "first sent by the Lord, and long resided here, bright as the morning star. Are not his Cán'dam," (the Jyána-bodhaca Cán'dam), "which, from soundness of religious doctrine, seems as if written in "rays of light, and his other works, well known and received as a sun of everlasting brightness that "hath never set. From that time to this, innumerable priests, devoted to their duty, have succeeded "each other in succession, like an undivided garland." (Part of the original is here omitted in the printed work). "But the prayers and sentences from the holy scriptures, commonly used on "the sea coasts, as corrected by him (ROBERT NOBILI) according to the information he received from "the Bráhmans, either from his not comprehending the true meaning of some words, or from its "having been wilfully concealed from him, cannot be highly praised."—'For his sake charitable 'collections for the Bráhmans converted to the Christian faith, were at this time established in the 'congregation de Propagandâ Fide at Rome by the Cardinal ONOPERI' (?).

* THE fact is that ROBERT NOBILI uses the word Bráhmana always in the sense of priest, as indeed it is rendered though not with precision by Sir W. JONES in the institutes of MENU; thus he calls the high priest of the Jews and his associates Yúda-Bráhmana, and the father of the church Bráhma-Vádigal.

II.

Journal of a Survey to the Heads of the RIVERS, GANGES *and* JUMNA.

BY CAPTAIN J. A. HODGSON, 10TH REGT. N. I.

AS I have had it in my power to explore and survey the course of the *Ganges* within the *Himálaya* mountains, to a considerable distance beyond *Gangautri*, and to the place where its head is concealed by masses of snow which never melt, I hope, that an account of my journey may be acceptable to the Asiatic Society. I must premise that, as Captain RAPER's account of Captain WEBB's survey in 1808, has already appeared in the XIth Volume of the Researches, I have nothing to add to that officer's able and faithful description of the mountainous country, passed through in the route of the survey from the *Dún Valley* to *Cajani*, near *Reital*, where the survey towards *Gangautri* was discontinued in consequence of the serious obstacles which impeded it. I shall therefore only give an account of the course of the river above the village of *Reital*, where I halted to make arrangements for my progress through the rugged regions before me, in which I found I had no chance of getting any

supplies of grain for my followers: I was consequently obliged to buy grain and to send it off before me, so as to form little magazines, at the places I intended to halt at; and as I learnt that several of the *Sangas* or spar bridges over the river had been destroyed by *avalanches* of snow, I sent a large party of labourers to re-establish them.

CONSIDERING *Reital*, as a point of departure, it will be satisfactory to know its geographical position. By a series of observations with the reflecting circle of TROUGHTON, and also by his astronomical circular instrument, I found the latitude to be 30° 48′ 28″ N. and having been so fortunate as to get two observations of immersions of the first satellite of Jupiter and one of the second, I am able to give a good idea of the longitude of the place; and the more satisfactorily, as two of the immersions are compared with those taken at the *Madras* observatory on the same night, and with which I have been favored by Mr. GOLDINGHAM, the astronomer there.

THE telescope used by me in observing the satellites was a DOLLOND's forty-two inches achromatic refractor, with an aperture of two and three-quarter inches and power of about seventy-five applied, having a tall stand and rack work for slow motion. The watch was a marine chronometer, made by MOLINEUX of *London*, and went with the greatest steadiness on its rate, as nightly determined by the passage over the meridian of fixed stars observed with a transit instrument. The time of mean noon when required was always found by equal altitudes.

	H.	M.	S.		H.	M.	S.	
12th May, 1817.—Observed immersion of ♃ 1st satellite at mean time,	10	42	56	0				
The same observed at the *Madras* observatory,	10	49	59	9				
Differences of meridians in time,	0	7	3	9				
Established longitude of *Madras* observatory,	5	21	14	0				
Longitude of *Reital* deduced,					5	14	10	1
By the calculation in the nautical almanack, it was anticipated that this immersion should happen at *Greenwich*, at	5	29	33	0				
It took place as above at *Madras*, at	10	49	59	9				
Which would make the longitude,	5	20	26	9				
But it is known to be,	5	21	14	0				
Difference,	0	0	47	1				
Therefore the error of the tables at this time is to be applied to the following immersion:								
10th May, 1817.—I observed an immersion of the 1st satellite, at	16	14	21	1				
There is no correspondent observation at *Madras*, but the nautical almanack, gives for *Greenwich*, 11h. 1m. 5s.								
The above error of the tables 47 1								
11 0 17 9	11	0	17	9				
Longitude of *Reital* deduced,					5	14	3	2
Mean,					5	14	6	6

BOTH the observations were made under favorable circumstances, the air being still and clear. On the 10th, the satellite began to lose lustre about 44; and on the 12th, 50 seconds before its disappearance.

	H.	M.	S.	
11th May, 1817.—I observed the immersion of ♃ 2d satellite, at *Reital*,	14	13	35	7
Same was observed at *Madras*,	14	19	41	1
Difference of meridians,	0	6	5	4
Established longitude of *Madras* observatory,	5	21	14	0
Longitude of *Reital* deduced	5	15	8	5

THIS was a very distinct observation, and I followed the satellite deep into the shadow, it gradually losing light for 76 seconds before its total disappearance—yet it gives a longitude almost a minute East of the first satellite, the preceeding night, which leads me to suspect, that though I know the seconds were rightly counted and noted, that the minute may have been inadvertently noted 13^m instead of 12^m. As there is this uncertainty, I will reject the observation: nevertheless it may be interesting to know, supposing that the case, what the longitude could come out:

	H.	M.	S.	
Suppose at *Reital* the immersion took place at	14	12	35	7
Madras,	14	19	41	1
		7	5	4
Madras,	5	21	14	0
	5	14	8	6
Mean of 2 nights—1st and 2d satellite,			6	6
	H.	M.	S.	
By the nautical almanack the immersion was expected at *Greenwich*, at	8	57	42	0
It happened at *Madras*,	14	19	41	1
Giving a longitude of	5	21	59	1
But the longitude is	5	21	14	0
Correction of the tables,			45	1

BY a mean of several observations taken at *Madras* about the time of 4 *Emersions* of the first satellite, which I observed at Mr. GRINDALL'S house near *Seharanpúr*; Mr. GOLDINGHAM finds 5^h 10^m 24^s for the longitude of *Seharanpúr*.—A snowy peak called *Srí Cánta* is visible both from *Reital* and *Seharanpúr*, its position is determined by means of a series of triangles instituted by me for the purpose of taking the dis-

tances and heights of the snowy peaks. I find the angle at the pole or difference of longitude between *Seharanpúr* station and *Srí Cánta*, to be 1° 14′ 47″—the peak being East, and at *Reital* the difference of Longitude of that village, and the peak, is found to be 12′ 6″—the peak being East, consequently the difference of longitude of *Seharanpúr* and

	h.	m.	s.	
Reital, is......................................1°, 2′, 41″ in Time=0h.		4m.	10s.	7
Longitude of *Seharanpúr* by the emersions of the first satellite, ...	5	10	24	
	5	14	34	7
But the mean of the second immersion of first satellite gives	5	14	6	6
Mean of emersions and immersions, ...	5	14	20	6

Four sets of distances of the sun and moon with the reflecting circle, on the 8th May, gave 5h. 14m. 25s.

ON the whole I think $5^h\ 14^m\ 20^s 6$ or $78°\ 35'\ 60''\ 7$ may be safely taken for the longitude of *Reital* East of *Greenwich*.

REITAL, contains about thirty-five houses and is esteemed a considerable village; as usual in the upper mountains where timber is plentiful, the houses are large and two and three stories high. When a house has three stories, the lowest serves to shelter the cattle by night; the second is a sort of granary and in the upper the family dwells; round it there is generally a strong wooden gallery or balcony, which is supported by beams that project from the walls. The roofs of the houses are made of boards or slates: they are shelving, and project much beyond the top of the walls, and cover the balcony, which is closed in bad weather by strong wooden shutters or pannels. These houses are very substantial and have a handsome appearance at a

distance, but they are exceedingly filthy within, and full of vermin. The walls are composed of long cedar beams and stone in alternate courses, the ends of the beams meet at the corners, where they are bolted together by wooden pins. Houses of this construction are said to last for several ages, for the *Deodar* or *Cailon* pine, which I suppose to be the cedar of *Lebanon** is the largest, most noble and durable of all trees.

THE situation of this village on the east side of a mountain, the summit of which is covered with snow, and the foot washed by the *Bhágirathí* is very pleasant. It commands a noble view of the *Srí Cánta* and other adjoining peaks of the *Himálaya* on which the snow for ever rests. Snow also remains until the rains on all the mountains of the second order, which are visible hence, both up and down the river. Many cascades are formed by the melting of the snows on the foot of the surrounding mountains. One in particular descends in repeated falls of several hundred feet each, from the summit of a mountain across the river and joins it near *Batheri*.

THE azimuth of the *Srí Cánta* peak (determined from the elongation of the pole star) is 50° 49′ 29″ N. E. and its altitude 9° 14′ 3″ 5. It is needless here to insert the observations of azimuth and altitudes of the other peaks seen hence and at other places on the route. In the following account of my progress up the river, I have put down such remarks as occurred at the time, and they were written on the spot, and are here in-

* It is the pinus *Deodára* of ROXBURGH; the *Dévadáru* of *Sanscrit* writers. H. H. W.

serted with very little alteration. Though, I am aware, that such minute descriptions of localities must appear tedious, and that many repetitions occur, I hope, they will be excused by those, who feeling interested in the subject, may have the patience to read the detail. To give *general* descriptions of such rude regions is difficult, if not impossible, and I trust that particular ones, though often tedious, will be found more faithful, and to give more precise ideas, of those remote recesses of the *Himálaya*, which I visited. For this end, and that those who are so inclined, may be able to know the positions of the places, in my journey, I have put down the bearings, and distances in paces, of each portion of the Route, with the remarks noted at the time and also the latitudes of the halting places, and these simple data will enable any one to trace the distance and direction from *Reital* to the end of my journey. I have only put down the bearings in single degrees; they are reckoned from North, which I call 360: thus, 180° is South, 270° West, and so on—except in very steep ascents and descents, the paces may be taken at 30 inches.

ON the 19th May, I was joined at *Reital* by Lieutenant HERBERT, of the 8th Regt. N. I. who had been appointed my assistant, and from his skill and zeal the survey has received much benefit.—Mr. HERBERT came direct from *Calcutta* and brought for me a pair of Mountain Barometers, but the tubes filled in *England* had been broken ere they arrived in *Calcutta*: there were some spare empty tubes which we filled and used as hereafter mentioned, but we could not succeed in boiling the mercury in the tubes, to free it entirely of air.—The height of *Reital* above the sea as indicated by our barometers is 7108 feet.

HAVING received reports, that the *Sanghas* were repaired and that the grain I sent forward was lodged in the places I directed, I left every article of baggage I could possibly do without, and having given very light loads to the *Coolies* that they might proceed with less difficulty, we marched from *Reital* on the 21st May, as follows:

21st May, Reital to Tawarra, Thermometer at Sun rise, 52°.

		Paces.	Degrees.
1	Slight oblique descents through fields. Cross a torrent, 10 feet wide, ...	1510	328°
2	Along hill side, slight ascent and begin descent. Flag staff at *Reital* 8°. *Wuddr* 138°. The great water fall across the river joins it, at 143	1052	66
3	First 200 paces 315° along side of hill. Top of *Sálang* mountain covered with snow 95°.....	592	69
4	Ascent rocky and rough. Observed some *Micaceous* iron ore. *Pollang* 13°: river below to right, 1 mile distant, ...	632	45
5	Leave *Pollang* 1 furlong to right. *Sálang* mountain 112. *Sálang* a large village across the river 90°........................	1040	353 & 45
6	Descent and cross the *Soar* river on a *Sangha* 5 paces in length. It falls in a fine cascade from a great rock. The scenery very picturesque; course of the *Soar* down 100° where it joins the *Ganges*, ...	1020	316

7	Very rough, along steep side of the rocky mountain of *Narantah*; last 400 paces, steep ascent by short zig-zags. *Pollang* 169°; *Sálang* ...	1328	5
8	Oblique and rocky ascent, open to right, high precipices above to left. *Sálang* 125°	1880	67
9	Crest of the ascent to it a very bad and rocky broken path, difficult and some what dangerous in some places, where a false step would be fatal. *Sálang* 137°; *Sálang* mountain 121°; *Reital* 203°; *Pollang* 208°; course from the *Sangha* generally 57°; Mouth of the *Soar* 159½°. *Ganges* 1½ mile right and about 2,000 feet below, ...	883	
10	Descend and cross *Cajani Nadí* rivulet 4 paces, oblique descent and better path, ...	1320	311
11	*Cajani* or *Kujnah Hamlet*, ascent, ...	350	92
12	Rocky oblique ascent; *Reital* 206°; *Sálang* 172°	2090	72
13	More heavy ascent of the same kind, over fragments of granite mixed with large proportions of quartz and feld spar, ...	805	67
14	More ascent but not quite so rough.—Here slight descent,		

Reital (my Flag Staff there) 209°. Depression of top of the mast 4°, 23'; Bottom 4°, 30'; *Pollang* 214° 42'; Depression 8° 14; *Sálang* 187° 44'; Depression 12° 44": *Bús* or *Sálang*

peak 144° 03″; Elevation 11° 09′ 5; *Húrí* 46° 20′; Depression 4° 3½; Direction of *Dangal* 36¼; Highest point of *Sricúnta* 55° 4′ 7; Elevation 10′ 32; *Túbú Gawana* 331° 31′; Elevation 17° 55′. Second point 335° 19′ 8; Elevation 17° 56′. Third point 355° 06′; Elevation 17° 55.

Tawarra, a ruinous village of 10 houses, ...	600	12
Marched the distance in 5 hours and 38 minutes, ...		
	15,052	

FROM the *Soar* river to immediately above *Tawarra*, the path is exceedingly rugged, over broken masses of rock; the whole is an ascent; and in some places very steep open precipices to the right and high rocks above to the left; precaution is required in the footing, and some places are very unpleasant to turn, where it is adviseable to go bare footed.

THE mountains are of granite, with various proportion of quartz and feldspar, of which I have specimens. Heavy rain both on going and returning, could not get a latitude. Water boiled at 198°; the temperature of the air being 67°.

AT the village of *Tawarra*, direction of the small lake called *Cailac Túl*, whence the *Dinni Gárh* river issues 71°. It is said to be 50 yards in diameter, but deep, and is formed by the melting snow; there is a small piece of level ground near it, to which the villagers drive their sheep to pasture in August.

	22d May, Tuwarra to Dangal, Thermometer sun rise 48°	Paces.	Bearing from N. Degrees
1	Descent through the fields and down the *Dell* steep and slippery. *Rhoh* (or *Rhqi*) pines and the *Mohora* a species of oak grow here, ...	1310	3
2	Descent to the *Elgie Gárh* torrent.—Cross it by a *Sangha* 15 feet long. Granite rock in large blocks, with quartz nodules and bands in the bed of the stream, ...	1320	70
3	Descent by the torrent side, leave it and cross a crest or ridge. *Búci* 160°, ...	1630	71
4	The path is along the steep and broken sides of a mountain, &c. very bad, last 500 yards difficult; turn some what dangerous corners, mouth of the *Dinni Gárh* 100°. The stream about 20 feet wide, and is a sheet of foam falling at an angle of about 20° to the *Ganges*, Direction of the small lake at its head 130°; *Reital* 210°; *Ouri* 40°; *Buci* 179°, ...	1810	42
5	Oblique descent to rivulet and water fall of 20 feet,	1010	350
6	Oblique rocky ascent, ...	1320	35
7	Along the side of mountain rocky; one difficult place: here begin descent towards the river—*Reital* 208°; *Buci* 198°; *Salung* 206°; *Ouri* 45°; angle of depression of our path to the river 17°. It is 4 furlongs direct to right and deep below, ...	1600	43

8	Cross *Camaria Gádh* (rivulet) 8 paces wide,..	1710	50
9	Down the narrow glen of the rivulet to its junction with the *Ganges*; the whole a descent, and in many places bad and difficult, over large blocks of rock which have fallen from above, and overturned and shattered all the trees, in their course. The granite precipices, which confine the river at this place, nave split and fallen in large masses into the bed of the stream,	1360	50
10	Path along the side of the *Ganges*, but above it. A cascade opposite falls 800 feet, but not in one sheet, river up to 6°; path rocky, ...	1860	42
11	Across the river and on its steep bank is a range of hot springs; they throw up clouds of steam, and deposit a sediment of a ferruginous colour; these are the first hot springs I have observed on the *Ganges*; the river not being fordable, we cannot go to them,......................	1000	6
12	Huge blocks of rock fallen to left,.............	560	6
13	Climb over and under the ruins of a most tremendous fall of the precipices; blocks of granite from 100 to 150 feet in diameter are thrown on each other, in the wildest and most terrific confusion: the peak whence they fell is perpendicular and of solid rock. This fall took place 3 years ago, ...	2120	350

Path better, ...	320	352
Cross the *Ganges* by a *Sangha* made of two stout pine spars, laid from rock to rock. It is a good bridge of the kind and about 3½ feet wide; the space between the pine spars is overlaid with small deal shingles which are tied together so as to form a platform.—Like all the rest, this *Sangha* is open on both sides, and unpleasant to pass, being from the length and elasticity of the pines, so springy as to re-bound to every step the passenger takes.—The river below the *Sangha* was deep, and very rapid, being confined by rocks. Its breadth under the *Sangha* as measured by a chain was 50 feet, height of the *Sangha* above the stream 30 feet.—The river is more expanded above and below — *Sanghas* are always placed in the narrowest parts, ...	400	20
Tent at *Dangal*, a small flat so called, on the left bank of the *Ganges*, and at the confluence of the *Limea*, a large torrent—No village here. The halting place is surrounded by high and steep rocky mountains and mural precipices: observed some bears climbing among the rocks.	230	31
	19,569	

Time of marching 5 hours and 48 minutes, a very laborious journey. The path is very rough and merely a succession of steps from one broken crag to another; some places were very difficult. To the *Ganges*, was descent, then we passed along its bank, and at no great height above the stream, which though not wide is deep, and impetuous, falling from rock. In the less rapid parts pools are formed, where the breadth may be 200 feet, but generally it appears from 100 to 120 feet wide; several rills besides those noted above, fall into the river; it is needless to say, that they fall in cataracts, the sides of the river, being every where bounded by high cliffs. The rocks are granite, of much the same composition, as on yesterday's march. The dip of the *Strata* is about 45° towards N. E. as usual, and the whole line of inclination is visible from the river to a great height above. Water boils at 202°—The temperature of the air being 54°. On our return, the Barometer was deranged at this place. It is to be remarked, that on going up we did not fill the Barometers, fearing they might be broken, and the Mercury spilt, of which we had very little; our store of it having been diminished, by those various accidents to which every thing that can be lost, or broken, in these rough regions is subject. Of these Barometers more hereafter.

Latitude Observed.

	°	′	″	
M. A. Spica. Reflecting Circle, HODGSON'S	30	54	32	8
Lieutenant HERBERT'S....			28	8
Mean......	30	54	30	8

23d May, Dangal to Súri.

		Paces.	Degrees
1	Lofty cliffs on both sides of the river; path generally a slight ascent but rocky and difficult,...	1005	14
2	Along the bank of the river. On Rocks. *Narai* peak crowned with snow, 43°. *Kanouli Gádh*, torrent falls in cataracts from right bank 15°; *Bús* peak 180°,..............................	800	3
3	Path rocky and rough above the river,........	1005	10
4	Path ditto, granite rocks, steep and high on all sides,....................................	1010	18
5	Cross the river on a *Sangha* at *Deoráni Gháti*, it is a new and good bridge of the kind, but long and very elastic; height above the stream, 40 feet, breadth of stream under the *Sangha* 30 paces or about 60 feet The high flood mark of the stream when swollen appears to be about 14 feet, above the present level. A wild and savage looking place. Precipice around, granite and some black and grey rock of a laminar texture.—Rocky path from last station.—Pines of various kinds, and the true deal fir grow here: immediately on passing the *Sangha*, the path leads over an *Avalanche* of snow which reaches to the river's margin; it is many feet thick, and has fallen this year, and brought down all the trees in its path. This		

is the first snowbed we passed over on the *Ganges*.

6 Path along right bank. The river a bed of foam falling from rock to rock. Five hundred yards further on, are the falls of *Lohari Naig*, where the river is more obstructed than in any part of its course and tears its way, over enormous masses of rock, which have fallen into it from the mural precipice which bounds its left shore. This frightful granite cliff of solid rock, of above 800 feet high, appears to have been undermined at its foot by the stream, and the lower and middle part have fallen into it, while the summit overhangs the base and the river— The vast ruins of this fall extend for about a quarter of a mile; the river has now forced its way through, and partly over the rooks, with a noise and impetuosity, we thought could not be surpassed, but on our return in June, when the *Ganges* was doubled in depth, the scene was still grander. It then just covered the tops of the rocks, and one of the falls of the whole stream, we estimated at 25 feet perpendicular, and below it were more, close to each other of little less height. The scene is full of sublimi-

ty and wildness, and the roar of the water is astounding.

On the right Bank also, there has been a recent large slip of the mountain, but the above mentioned on the left bank, is for its height, the most formidable fall I ever saw. It is not recent.

7 Cross the *Ganges* by the *Sangha of Lohari Naig* 16 paces long and 25 feet above the stream; which is here narrow, deep, and has a great fall; the ends of the *Sangha* (which is very narrow) are supported on each side on 2 great tabular granite rocks. That on the right bank is circular, and 150 feet in circumference. It is of a coarse brown granite, with quartz intermixed, and is decomposing in some places. The mountains on both side of the river are very steep. On the left bank of the river observed a rill, impregnated with calcareous matter, which is so abundant as to incrust every thing it touches very strongly, and we collected large pieces of this lime, which is pure, like that at *Sansár Dhára*—This is a singular thing in a region of granite........................ 1410 26

8	The *Lot Gárh* river joins the *Ganges*, cross it by a good little *Sangha*. This river is 20 feet wide. This last station has been almost level, and a good and pleasant path, along a flat of 150 yards wide by the river side, shaded by *Cáksi*, *Mírei*, *Omil*, and other trees. From the edge of the flat, the rock rises in a gigantic mural precipice of about 1500 feet perpendicular, and the same across the the river. *Strata* much inclined. The *Lot Gárh* river, comes from the snow to the right, and is very rapid. *Ganges* here expanded and the scenery beautiful. *Lot Gárh* up 120..........................	1500	25

On our return breakfasted here,

	In.	
Barometer...........	23	144
Thermometer attached	53	
Detached..........	56	

9	Pleasant path and good by the river side, which is more expanded, and the channel not so rocky. Breadth 150 to 200 feet, a snow *Avalanche* here, leave the low bed and begin ascent,....	1008	8
10	Strong ascent, first 500 paces, East, then 5°; here begins very steep ascent,.......................	1392	90 / 50
11	Very steep and difficult descent, open to the left, and the river deep below, a mural precipice,		

	across the river with well defined strata, at an angle of about 45°. The strata are so arranged in these regions, which are the feet of the *Himálya*, but I have observed, that near the tops of the *highest* peaks, the layers of rock are *nearly horizontal.* Name of above mountain *Baldera Lúru*; steep as it is and nearly devoid of soil, the pines nevertheless contrive to fix their roots in many parts of it,................................	510	300
12	Bad and narrow path overhanging the river. The *Soan Gádh* (river) joins the *Ganges* below, to West; course from snowy peaks 286°, appears to be 30 feet wide and not fordable, very rapid,......................................	548	360
13	Oblique descent, not steep, but difficult over lumps of broken rock, the ruins of a slip of the mountain,................................	792	5
14	100 feet of ascent, at an angle of 70°, rest, descent of the very steepest kind; in the worst part, the path is narrow, and over hangs the river, 2 or 3 places are unpleasant to pass,...........	592	5
15	Last 1000 paces an agreeable change, being a good path where one may walk at ease, *Avalanche* of snow to right, and a large slip of the mountain, the ruins of which obstruct the path,	2500	8

16	Bad and rough, here cross the *Gangea* on a *Sangha*, about 45 feet above the stream, breadth of the roaring stream below 17 paces, or 42 feet. The bridge about 2½ feet wide, ill secured and unsteady, it extends from one large rock to another. The current extremely violent, and the fall of the river great,......	1270	5
17	A Torrent from the *Suci* mountain falls in here, at this *Sangha*, on return, barometer 22in. 90. thermometer, 52..........................		
18	Long ascent to *Suci*, a decaying village of 9 houses, of which 3 only are inhabited. It is on the West side of a mountain, and surrounded on all sides, by the *Himálya* rocky precipices, crowned with snow. The river is about 1,000 feet below, foaming in a confined channel, ...	3000	5
		19,394	

As to the march, it was very long and laborious, we performed it in 7 hours, propably $\frac{2}{5}$ of it was hand and foot road. The rest except the two places of flat mentioned above as usual, a succession of long strides or little careful steps from one broken crag to another. The three *Sanghas* over the river, having been lately repaired are not dangerous, but too high, narrow, and elastic, to be pleasant to cross: the people from the

plains passed them very well (three persons excepted) but many of the mountain coolies, were obliged to be led over, with their eyes shut, as well as some of the *Goorkha* sepoys. To get well over them, it is proper to take careful steps (but not to go too slow) and to keep ones eyes steadily fixed on the platform, and by no means to look over the side, at the foaming gulph below, or to stop or hesitate when on the *Sangha*. The scenery to day was in nature's grandest and rudest stile, wall like precipices of compact granite bounding the river on both sides, to the immediate height of 2 or 3,000 feet: above those cliffs is snow.

Latitude Observed. M. A. Spica.	HODGSON; Circle,..	30°	59'	40"	5
	HERBERT; Sextant,...	30	59	40	
	[illegible]	[illegible]	59	40	25

24th May, Súci to Deráli, Thermometer Q. R. 45.

		Paces.	Brg. from Sta. Degrees
1	Road along side of mountain, moderate ascent........	742	46
2	Crest of rise—*Ganges* up 14°........................	510	46
3	Descent and cross the *Ganges*, by a *Sangha*, length of the Bridge 115 feet, breadth 3 feet—breadth of the river: below, 82 feet—depth to the surface of the water, from the *Sangha* 19 feet (measured by the chain). This is the best *Sangha*, on the river and the water below is not so rapid as usual—*Jhala* village of 5 Houses, 340°; above *Jhala*, the country is		

not at present inhabited, ... 1300 18

4 A fine view up the river which for several miles above this, flows in a more expanded bed in a narrow valley; the feet of the mountains bounding it, are less steep, and are clothed with cedars. Good path along sand and pebbles in the river's bed, the current of which more gentle though very swift. The bed is about 600 yards wide, and will be overflowed when the river is at its height. Lower line of snow, generally, 2000 feet, above the river, though several *Avalanches* reach down to its margin, *Jhala* 220; *Soan Gádh* river (mouth of) 6°. The air is very cold, ... 2000 11

5 Ascent and descent of a rocky point above the river. We have now turned the snowy range, seen from the plains, and brought it to our right, as will be seen by the change in the course; the march from *Dangal* to *Suci*, and on to this place, may be considered, as in that gorge of the *Himálaya*, through which the river forces its way, to the foot of those mountains of the second order, which are the beginning of the spurs of the grand range. We have now the great snowy peaks on both sides of the river, and it is henceforward bounded by them; those to the right, are visible from *Hindustan;* those across the river, or to our left, are not visible from the plains, being hid by the southern

ridges. The line of the outlet of the river is very perceptible from the plains, and the *Srícánta* peak, the western foot of which it washes here, is conspicuous from *Seharanpur*, and the *Doab*. From hence onward, the course of the *Ganges* is to be considered, as being within the *Himálaya*, differing from the *Jumna*, in as much as that the source of the latter river, is at the south west feet of the snowy peaks, seen from *Seharanpur*, and not within the *Himálaya*.

6 Pleasant and level; a snowy peak towards *Barrasah* shews itself up the *Soan Gádh*: it is called *Dumdana*, and is very white with snow; mouth of the *Soan Gádh* 322. Down its bed the plunderers from *Barrasah*, and the western districts of *Rawaien* penetrate in the latter end of the rains. As far as *Barrasah*, the country is uninhabited for six days journey except at *Leuh panch Gong*, which is three *Coss* on this side of *Barrasah*. Those districts are on the *Tonse* river, and are the seat of numerous gangs of plunderers and murderers, who much infest this part of the country, ... 595 50

7 Pretty strong ascent, but good path, in the cedar forest, obliquing up and down, from the river, ... 2200 { 51 88

8 Pleasant in a forest of many pines, ... 438 { 78 3

9 Ditto; top of oblique ascent. Descent to dell, ... 350 90

10	Descent to brow of small precipice, overhanging the river which here falls at a considerable angle. Mouth of the *Háril* large rivulet 345°, 7 furlongs, comes from 30, from snowy peaks. Here forest of cedar and the true deal pine which is a tall and graceful tree,....................................	600	100
11	Ascent and descent to precipice over the river. Across the river is a small plain of ½ mile wide, where there was once a village, called *Suor*,....................	415	80
12	Cross a torrent from the snow,...........................	265	80
13	*Búghti Gádh* (torrent) falls in opposite at right angles. Here oblique descent, cedar forest,..........	335	ditto
14	Descent to the bed of the *Ganges*, and cross the *Tíl Ghár* a large torrent, which falls in a most beautiful and picturesque cascade of 80 or 100 feet, over a rock, bordered and shaded by high feathery pines and spreading cedars,..................................	495	90
15	Flat, over sand and pebbles of the river bed, here expanded,..	500	75

On our return we halted at this place to take the altitude of two very sharp snowy peaks, which now appeared to the south, or to our right. We measured carefully with the chain, a base of 165 feet, which was the greatest extent of level ground to be found; with this base we found a longer line of 1568 feet, and from its extremities, determined the distances of the two

peaks, and their heights above the east end of the base as follows:

First peak called *Sewmarcha Chauntal*, distance 16418 feet, bearing due south. Its angle of elevation 26° 43' 42" and height above the river 8278 feet.

Second peak no name, but it is a lower part of the *Srícánta* mountain.

Distance 15374 feet.

Magnetic bearing 170° 43'.

Angle of elevation 25° 55' 30".

Height 7473 feet above the river.

Barometer 22 inches, 249: thermometers attached 79°.

Detached 78°.

16	Last 700 paces 82°, and ascent first part flat,........	1700	75 / 82
17	N. B. On our return we found gooseberries at this place: they were of the large hairy kind, and though not ripe, made good dumplins,....................	1090	63 / 74
18	Gradual descent, and cross the *Kheir Gádh* large rivulet, by a *Sangha*, at *Derali*, a village of 6 houses but now deserted, on account of the failure of the crops and incursions of banditti,..........................	810	88

Miles by the wheel 7^m 6^f being 16200 yards for paces, 14345

The road to-day, considered as a mountain path, was excellent, two or three places excepted. The north bases of the mountains which we passed

along, are moderately steep, and are clothed with noble cedars, and various sorts of large pines, of which the *Cshír* and *Rhai* or *Rher* are the largest; *Cshír* is a name indiscriminately given to several of the large leaved pines, but the tree so called here, is the true Deal; it grows to a great height, and bears a resemblance to the common *Cshír* or turpentine fir, which abounds in the lower hills, but which is never seen in company with the cedar, (*Deodár*) I took some specimens of this Deal, it is light and has a fine grain: the *Rhai* is a lofty pine, it has a graceful appearance, the leaves are pendent. The wood of it is not esteemed for building, being heavy and knotty: the cedar is always preferred for that purpose. From the *Sangha* to *Deráli*, the *Ganges* flows in an expanded bed with a swift current over stones. Yesterday it was a succession of falls from rock to rock, and bounded by frightful precipices. To-day the scenery was very interesting, the river being bounded immediately to the north by the cedar forests, above which, towered the sharp snowy peaks, and many torrents and cascades fell from them. I never made a more delightful march; the climate is pleasant and the weather bright to-day. The village of *Deráli* is situated in a rocky recess and commands a fine view of the river, and of the north sides of the snowy peaks behind *Jamnautri*. There are three small temples of stone by the river side, they are of good workmanship. *Derali* was plundered last year by banditti from the westward.

	°	′	″
Latitude Observed M. A. Spica. Reflecting circle,	31	2	25
Lieut. HERBERT, M. A. D. Sextant,............			8
Mean,............	31	2	16 5

Pole star hid by the mountains as usual.

25th May, Deráli, to Bhairo Gháti. Thermometer, sunrise 54° , [illegible]

		Paces.	Degrees.
1	Much rain here this morning, and snow above; a steep and almost perpendicular ascent, from the village up a mass of rock, ...	310	85
2	Cross a torrent 7 paces wide on a *Sangha*; path in general level on the banks of the river but occasionally slippery and bad, ...	1400	78
3	Road generally level along bank in the cedar forest. Cross a large snow avalanche, ...	1300	89
4	Road as above, cross a large avalanche of snow. Cedar forest; rocky mountains across the river almost perpendicular, ...	1800	73
5	Crest of nearly perpendicular and difficult short ascent; crags overhanging and threatening to fall. The river bed the whole way broad and strong current. *Derali* 256°; lofty peaks on every side, rising immediately from the river. This place is 1000 feet above it. Cedars of great size here, ...	1210	68
6	Road generally level, on bank of the river: cross an avalanche of great magnitude, being a fall of lumps of snow like large rocks, it has brought down, and broke to pieces, all the cedar trees in its path; perpendicular, rocky precipices rise immediately from the river bed, to the height of 1500 and 2000 feet; high snow peaks on all sides, large cedars at their feet, ...	1900	103

7 Path as above in cedar forest. Wall like precipices of great height rise from the river bed, above them is snow,.. 1714 105

8 Cross *Lucunga* a small river on a *Sangha*, a little above its mouth, falls from the snow to right and joins the *Ganges*,.. 837 138

9 An exceedingly steep ascent; river not visible but close below mountains with bare peaks, not a blade of herbage on their rocky sides. In front *Decani* snowy peak 105, to our left a mountain called *T'hui*, the S. side of *Decani* is washed by the *Baghiret'hi*, and the N. side by the *Juhni Ganga* or *Jáhnevi*, their confluence being at *Bhairoghátí*. This place is called *Ratenta*, 780 140

10 Another steep and toilsome ascent,.................. 1065 110

Descent over broken fragments of peak. A rocky precipice nearly mural of 1000 feet, overhangs the right bank of the *Ganges*, which here as usual rushes over rocks with an impetuous and foaming current. In front is the gigantic peak *Decani* rising immediately from the bed of the river, on the left the almost equally high one of *T'hui*, below, immense masses of granite overhang the river. The scenery is very grand. Very large cedars here,.. 930 130

12 *Jáhnevi* river 72.. 843 102

13 A sweep from S. to E. brings us to that most terrific and really aweful looking place called *Bhairoghátí*.

The descent to the *Sangha* is of the steepest kind and partly by a ladder. The *Sangha* is inclined far from the level, and as seen from the height above it cannot fail to inspire the beholder with anxiety as to his safe passage over it. It is indeed by far the most formidable *Sangha* I have seen; the height of the platform above the river, we measured by dropping the chain; it was 60 feet; one is apt at first sight to estimate it at much more, however this height, added to the circumstances of the narrowness of the *Sangha* (about 2½ feet wide) its elasticity, and its inclined position, is sufficient to render its passage disagreeable, it being (like all the rest) quite open at the sides. It is laid from one side of the precipice to the other, the end on the left bank is the highest, the precipices in some parts are quite perpendicular, in most, nearly so, rising to the height of 3000 feet above the stream, they are of compact granite; on some ledges there is a little soil, where the cedars fix their roots. The river below the *Sangha* is closely confined by the wall like rocks, which are perfectly perpendicular, and its course is thus bounded, nearly to *Gangautri*. The breadth of the stream is about 45 feet, and it is deep under the bridge, ... 300

14 Turn to the left by a rocky path to our tent, ... 280 60

13,769

WHICH is in a very strange place for a tent to be in, and one of the most curious sights among many here, is to see a little tent pitched under vast overhanging masses of rock, at the confluence of these two rivers, the *Bhágírat'hí* and its foaming rival the *Jáhni Gangá* or as more properly called the *Jáhnevì*, the strange and terrific appearance of this place (*Bhairog'hátí*) exceeds the idea I had formed of it: no where in my travels, in these rude mountains, have I seen any thing to be compared with this, in horror and extravagance. Precipices composed of the most solid granite, confine both rivers in narrow channels, and these seem to have been scooped out by the force of the waters. Near the *Sángá*, the *Bhágírat'hí* has in some places scolloped out the rock which overhangs it. The base of these peaks is of the most compact sort of granite, it is of a light hue, with small pieces of black sparry substance intermixed. From the smoothness of the rocks which confine the stream and which appear to have been worn so by water, I think the stream must have formerly flowed on a higher level, and that it is gradually scooping its channel deeper, for it does not appear that the walls which confine the rivers, are masses fallen from above, but that they are the bases of the peaks themselves. Enormous blocks have indeed fallen, and hang over our heads in threatning confusion, some appear 200 feet in diameter, and here are we sitting among these ruins, by the fire side at noon.—Thermometer 52°. What are these pinnacles of rock, 2 or 3000 feet high which are above us like! I know not. To compare small with great, I think the aptest idea I can form of any thing that might be like them, would be the appearance that the ruins of a Gothic cathedral, might have, to a spectator within them, supposing that thunder bolts, or earthquakes had rifted

its lofty and massy towers, spires and buttresses; the parts left standing, might then in minature give an idea of the rocks of *Bhairog'hátí.*

THE great cedar pines those gigantic sons of the snow, fringe these bare rocks and fix their roots where there appears to be very little soil, a few also of the larger deal pine, are seen, but inferior trees do not aspire to grow here. The day is dull and rainy, and I cast my eyes up at the precipice overhead, not without awe, a single fragment might dash us to pieces. Avalanches of snow and rock such as we have passed to-day, and indeed for these three last days, shew by their effects, their vast powers of destruction, for they bring down forests, in their overwhelming course, and dash the cedars into splinters. These avalanches have all fallen this season, they have in places filled up the dells and water courses to a great depth with snow, and extend from the peaks to the margin of the river.

A PAINTER wishing to represent a scene of the harshest features of nature, should take his station under the *Sángá* of *Bhairog'hátí* or at the confluence of the *Bhágírat'hí* and *Jáhneví* rivers, here it is proper to take some notice of this latter river hitherto little known. Though the *Bhágírat'hí* is esteemed the *holy and celebrated Ganges*, yet the *Jáhneví* is accounted, to be and I think is, the larger stream. From a *Bráhman* who officiates at *Gangotrí*, and who has been up it, I collected some particulars which though perhaps far from correct, may serve to give an idea of it. By the course of the river is a pass to *Bhot* or *Thibet*, by which the people from *Reital* and the upper villages of *Rowaien*

go to get salt, blanket cloth and wool, in exchange for grain. The trade is trifling, and not more than 100 people go yearly, in the latter end of the rains the road is open. They carry their goods on sheep and goats. The *Bráhmaṅ* has been at the frontier village called *Neilang*, it is four long, and very difficult days journey. The first three days are up the course of the river, high above its bed, for the most part, but occasionally descending to it. It is exceeding steep and difficult.

1ST *Day*.—They go along the high precipice on the right bank of the river—a *Sángá* at the end of a long march. Very bad path—no village.

2D *Day*.—Having crossed, very bad path to *Cartchá* a halting place—no village. Cedar pines here.

3D *Day*.—On same bank of the river to *Handouly*, a halting place, but no village. Not a very long march.

4TH *Day*.—The frontier or (*Do-bháshiás*) village called *Neilang* in the district of *Tungsah*, at this village, the river seems (they say) but little diminished in size, and there is a *Sángá* over it. This man can give no account of its origin, except that he believes it comes from some hills in *Bhoat*. The first part of the course of the river upwards, so far as can be seen from *Bhairog'hátí* is 72° N. E. and from what I can understand, it appears that this river has its source to the north of that ridge of the *Himálaya*, which bounds the *Bhágírat'hí*, to the N. E. or on its right bank, and that, between *Bhairog'hátí*, and perhaps the third day's

march abovementioned, it forces itself through the range. The *Bráhman* says that at the village, and for the last day's march to it the mountains are bare of trees, and that they are not the *Cylás* mountains (i. e. not what we call snowy mountains, but that the *Cylás* peaks towards *Gangotrí* are seen to the right, and so they would be, if we suppose the course of the *Jáhneví* up, to be about N. 70 East; and the course of the *Ganges*, is, we know from hence considerably to the S. of East. By the way I may mention here, that *Cylás* is a general appellation for high ranges always covered with snow (in the same way as we say *Himálaya* or *Himáchul*, (which last indeed literally means snowy peaks). At *Neilang* the houses are built very low, on account of the high winds. Travellers suffer much from difficulty in breathing caused as they say by the *bic'h* or *bish* i. e. exhalations from poisonous herbs which grow on the high bare knolls. This frontier district of *Tungsah* appears to be considered to belong, to what they call here *Bhoat*. or *Thibet*, and they pay their land tribute to a collector who comes from *Chaprang*, of the distance or size or direction of *Chaprang* I could not get any satisfactory account, but it appears to be a *Chinese* dependency. The district also gives to the *Rájá* at *Bassáhir* a blanket per man every third year, and a small complimentary tribute of *Dác'h* (raisins) to the *G'harwál Rájá*. The inhabitants are called *Do-bháshiás* from their speaking the languages of both *G'harwál* and *Bhoat* and they act as interpreters and brokers.

THE exports from *Rawaien* are, rice, *mandwá* and *pápra* (coarse grains) *Tobacco* and *Tamashas*; Imports, salt, and thick woolen cloth and wool.

THE *Rawáien* people go in the month of *Cártic*, because the wool is then ready, but in the month of *Sáwan* the road may be passed, and that would be the best time to go.

HAD the season been more advanced and if I had had grain I should have been tempted to go up this river, it is an interesting object of future research, but there are many others and one does not know which to attend to first, but it is my intention to explore this river next season.

LATITUDE observed. Confluence of the rivers at *Bhairog'hátí*.

M. A. Spica. 4 sets 30°, 01', 38",·7 cloudy weather and no other star visible.

WATER boiled at 198°. The air being 44°.

ON return June 3d.—We encamped in a much better place, a small piece of flat at the summit of the cliff which bounds the *Ganges* on its left side. It was a pleasant and secure situation and under the shade of the cedars. At this place, about 700 feet above the river, the barometer (unboiled mercury) stood at 21in 524 tem perature of air 70°.

LATITUDE of this camp 30°, 01', 22",·5 good observations, junction of *Bhágirat'hí* and *Jáhnevi* rivers 72° distant 1 furlong.

26th May—Bhairog'háti to Gangótrí—Thermometer 40°

	Paces.	Brg. from N. Degrees.
1 A very steep and difficult ascent, we pass along the perpendicular face of the precipice by means of a scaffolding of two narrow planks, which appear very rotten and ill supported at the ends, under the scaffold is a chasm of 300 feet deep. Immediately afterwards ascend by ladders, the precipices bounding the river being here like walls and these scaffolds and ladders are laid from projecting points to enable one to pass,	330	170°
2 Three other passages along the precipices, and over chasms by means of rotten planks, then an exceedingly steep ascent by short zigzags to a flat, at the foot of *Decaní* peak, here is a small temple of *Bhairo Lál* who is esteemed the janitor of *Gangotrí*, at this place, pious *Hindús* leave their shoes, ...	475	21
3 Road tolerably level, winds rounds the South West side of *Decaní* peak, the river is about 800 feet below to the right and rising from its bed is a wall of mountains of a height I find it difficult to estimate, below to the river steep precipices—*Sewrí* peak 236° *Miánrí* peak 150°,..............................	700	110
4 Path very difficult, a few paces further on cross another frightful chasm by a platform of a foot or 18 inches wide—Road over masses of granite piled in confusion, they are fragments of a fallen peak. Looking up we		

		Paces.	Degrees.
	see the tower-like summits of *Decant* almost overhanging us. The whole way strewed with falls of rock from them. Many traces of bears—..........	630	160°
5	Wind round the brow of the hill, and come upon an opening where the eye is saluted with a full view of *Miání* peak, and in the distance the mountains of *Rudr Himálaya*, crowned by the peak of *Dugdi* towering to a great height, the pure snows on it shine in the suns rays with dazzling brilliancy,...........	690	140
6	Bad and slippery path, as before high rock above to left, the river deep below to right cedars here,...........	310	126°
7	Ditto..............ditto...............ditto........	230	133°
8	Rather better path, the river deep below foaming in its narrow, and rocky bed, most fantastic great snow peak over *Gangotri* 119°,		
9	Black rocky peak across the river—Call it Iron Sides 125° 30,......................................	1500	133
10	Better path but broken, and a torrent falls in from the snow across the river 200°—Iron Sides 129°—Cedars—Not much ascent or descent, path hence chiefly undulating and lying along the steep side of the mountain,	3900	127
11	A long steep side. River deep below in a steep confined channel of light coloured granite. Cedars here—Iron Sides 129°,....................................	720	127
12	Path as before, across the river is a cascade falling through a large snow bed, the snow reaches in several places		

		Paces.	Degrees.
	from the river bed on the opposite side to the summit of the mountains which are very steep. We are almost in sight of *Gangotrí*, ...	390	95°
13	The river flows under beds of snow which have fallen into it, from the peaks, and cover it, ...	1692	96
14	Steep ascent and cross a torrent, ...	292	32
15	Pass above a Cascade falling over a precipice of grey granite with black sparry spots. Wonderfully steep precipices on both sides of the river, on this side the rocks are quite bare and shattery, ...	1082	92°
16	Cross above a Cascade falling from a rocky gorge to the left—Path extremely bad. This river below foaming between walls of rock, perfectly perpendicular. A *Sángá* (now destroyed) had formerly been laid over at this place, by the banditti who in the rains plunder the *Cédárnáth* districts to the Eastward. The rocks through which the river flows have horizontal strata and the light hue of *Portland* stone—They are as usual, granite—The cedars here are poor and starved—Very high bare rocks above to left. *Rudr Himálaya* a snowy peak 95°, ...	1510	96°
17	Descent. *Gauricund* a small flat space by the river side—On the opposite side the *Cédárgangá* falls into the *Ganges* from 107°. It has no claim to the title of a River, being merely a torrent from the snow, of 10 or 12 feet wide and shallow. It comes out of a rocky		

	gorge, and its course cannot be longer than three or four miles,..	1352	105
18	*Gangotrí*. The small temple of *Gangá Máí* and *Bhágirat'hí*, on right bank of the *Ganges*,..........	575	Do.
		16,378	

THE path to-day was of the worst description, and is on the whole I think the most rugged march we have hitherto had, though there are not any long ascents. Nothing can be more unpleasant than the passage along the rotten ladders, and inclined scaffolds, by which the faces, and corners of the precipices, near *Bhairog'hátí* are made. The rest of the way lies along the side of a very steep mountain, and is strewed with rocks. The views of the snowy peaks which are on all sides, were very grand and wild.

THE rocks are of granite, but of a lighter colour than usual, and specks of a bright black sparry substance are interspersed in them, at the distances of from one to three inches.

THE rivers bed from *Bhairog'hátí* to *Gaurícund*, was between mural precipices of 2 or 300 feet high; above them was the steeply inclined ground, along which our path laid.—Though very rocky, there were many places with soil, where the cedars grew, but not large—Above the path to our left were bare rocky precipices, on the summit of which the

snow lies: at *Gauricund* and *Gangotrí*, the rivers' bed becomes more open.—The temple at *Gangotrí*, is a *Mundup* of stone of the smallest kind; it contains small statues of *Bhágirat'hí*, *Gangá*, &c. and it is built over a piece of rock, called *Bhágirat'hí-Śilá*, and is about 20 feet higher than the bed of the *Ganges*; and immediately above its right bank, there is also a rough wooden building at a short distance for the shelter of travellers.—By the rivers side, there is in some places soil, where small cedars grow; but in general the margin is strewed with masses of rock, which fall from the precipices above—the falls do not appear recent.

Too much tired to attempt to boil mercury in the tubes to-day.—At night, having prepared the instruments to take the immersion of one of Jupiter's Satellites, we laid down to rest, but between 10 and 11 o'clock, were awakened by the rocking of the ground, and on running out, soon saw the effects of an earthquake, and the dreadful situation in which we were, pitched in the midst of masses of rock, some of them more than 100 feet in diameter, and which had fallen from the cliffs above us, and probably brought down by some former earthquake.

THE scene around us, shewn in all its dangers by the bright moon light, was indeed very awful—On the 2d shock, rocks were hurled in every direction, from the peaks around, to the bed of the river, with a hideous noise not to be described, and never to be forgotten: after the crash caused by the falls near us had ceased, we could still hear the terrible sounds of heavy falls in the more distant recesses of the mountains. WE looked up with dismay at the cliffs over head, expecting that the

next shock would detach some ruins from them; had they fallen, we could not have escaped, as the fragments from the summit would have flown over our heads, and we should have been buried by those from the middle.

PROVIDENTIALLY there were no more shocks that night. This earthquake was smartly felt in all parts of the mountains, as well as in the plains of the N. W. provinces of *Hindustan*.

IN the morning we removed to the left bank of the river, where there is a bed of sand of about 150 yards wide; then is a flat of soil with trees of about 20 yards wide, and immediately above it are precipices with snow on them; here we were much more secure; in the afternoon, indeed, the effects of the snow melting, often caused pieces of rock to fall from above, to near our station, but we could avoid them by running over the sand to the river side, which could not be done on the right bank; besides only comparatively small pieces fell here, and in day light, so that this is much the best side to encamp on.—We had the curiosity to measure trigonometrically the height of the cliff, at the foot of which we were during the shock, and found it to be 2745 feet.

THIS day, the 27th, we had a slight shock of an earthquake, as well as so on the 28th.

Barometers.

Filled a new and full length clean tube with pure mercury, immediately after filling (unboiled), it stood at 29. 890 (In.)

Thermometer attached..78°

Ditto detached.........68°

Having hung the Barometer up in the tent, and allowed it to acquire the temperature of the air and adjusted zero, the following heights we observed:

Thermometer attached 77½° { upper surface of the
Ditto detached 63° { Mercury..............Inch 20. 8320

Second reading an hour afterwards, Mercury upper convex surface } ....20. 8065 At. Th. 69°

Lower part of head of column { .... 7335 Det. do. 67°
{ 7410

An hour afterwards upper convex...............20. 8255 Ther. 72°

Lower line............... 8080 61°

Afternoon, outside of the tent three hours after filling the tube;

Mean at 4 o'clock ....20. 7842 57°

There were very few and but small (Air) bubbles in the column, and the vacuum was evidently pretty good, as shewn by the smart cracking of the mercury against the top of the tube.

Water boils..................196°

WE now begin to boil the mercury in the tube. The tube as usual broke. None but a professed artist can expect to succeed in this difficult business, once in ten times.—With the unboiled mercury, there must be an error, but it should not, I think, affect the heights more than 200 feet, and generally not 100 feet; and as under the present circumstances we *cannot do* more, we must be content with such approximate

altitudes: and I reckon it of some consequence, to have the heights of these places even within 200 feet, as *hitherto no idea* could be formed on the subject.

WHEN a tube is filled with unboiled mercury, which of course contains air, it stands at first *higher* than it ought, from the air dilating the column; but, after a short time, much of the air escapes into the upper part of the tube, where the vacuum ought to be, and there expanding, presses *down* the mercury in the tube, thus making it *lower* than it should be. The mean height will not differ very much, perhaps not more than two tenths of an inch, in moderate heats, from that shewn by a boiled tube.

THE barometers I had, were 2 out of 6 sent from England, to the Surveyor General's Office; they were made by BERGE, and are very fine instruments, but so little attention had been paid to their packing, that the tubes of them all were found to be broken, when they arrived in Calcutta, as well as most of the thermometers belonging to them: there were spare, but unfilled tubes sent with them, and some of these would not fit.

WHENEVER barometers are sent, there should be to each at least 6 spare tubes *filled in England* by the maker, and hermetically sealed, and these should be carefully packed in separate cases of copper or wood, lined with flannel, and the scale *downwards* should go to 13 inches: the

scale of these barometers only reaches to 19 inches. In instruments intended for *India*, *solidity* should be considered; we want those which will do their work *effectually*, and are not anxious that they should be *small* and easily *portable*, as we can always here find means of carrying them. The mean height of the column, by such observations as I thought most to be depended on, is 20. 837 in.; the temperatures of the air and mercury being 73° and 65°. From which, the height of *Gangautri* above the sea, calculated by M. RAYMOND's method, is........ 10319·4 feet

By Dr. HUTTON's method 10306.6

Latitude observed 27th and 28th May, 1817.

	°	′	″	‴
By me, reflecting circle, alternate faces, mean by A. and B. Libra..	30	59	29	
Large Sextant by BERGE—Lieutenant HERBERT, 4 sets ditto,			35	5
By me, reflecting circle—8 circummeridional altitudes of Spica, being 24 indexes, on alternate faces......			27	1
Mean latitude of *Gangautri*..	30	59	30	5

THESE were good observations, and refraction is allowed on the altitudes, according to the barometer and thermometer; and all other corrections for precession, aberration, nutation, &c. are applied as usual.

THE pole star could not be seen on account of the height of the cliffs,

nor any star to the south lower than those observed.—The same cause most unfortunately prevented our being able to observe any eclipses of Jupiter's Satellites here, or the occultation of the star ♎ Libra by the Moon, and I was sorry to find that my chronometers could not be depended on to shew the difference of longitude in time: though they are of the best kind, and hung in gimbals, no method of carriage that I had *then* adopted could prevent them feeling the effects of the short and continually repeated jerks they received from the uneven steps, which the man who carried them on his back was obliged to make. Nothing except a staff can be conveniently carried in the hands, as they are so frequently employed in assisting the feet in difficult places.

THE *mean* breadth of the *Ganges* at *Gangotri* was (measured by the chain) 43 *feet*, depth 18 *inches*, and nearly the same depth at the sides, as in the middle: the current very swift, and over large rounded stones.—*This* was on the 26*th May*, the stream was *then* in one channel, but the effect of the sun in melting the snow was at that season so powerful, that it was daily much augmented; and on our return to *Gangotri*, on the 2*d June*, the depth of the main stream was 2 feet, and it was a few feet wider (but I did not then measure the width); several shallow side channels had also been filled in the interval, and on the whole, I estimate, that the volume of water was doubled.

THOUGH the frequency of the earthquakes made us very anxious to get out of our dangerous situation in the bed of the river, we resolved, as we had come so far, to leave no means untried to trace the stream as far

as possible, and accordingly set out on the morning of the 29th of *May*, hoping to arrive at the head of the river in the course of the day.—The two *Gangotrí Brahmins* could not give any information as to how far it might be distant; they had never been higher than *Gangotrí*, and assured us, that no persons ever went further, except the *Múnshí*, who appears, by the account in the *Asiatic Researches*, to have gone about 2 miles.

MR. James Frazer visited *Gangotrí* in 1815, and was the first *European* who did so.

May 29th. From Gangotrí, forward up the Ganges.

		Paces.	Degree.
1	Pass avalanche, and fragments of rock newly fallen, and which cover the path	600	88°
2	Ascend a snow bed, which covers the river, it is about 30 feet thick	524	ditto
3	Over the snow bed, and descend to the open stream. Here a gorge of huge rocks obstructs the stream: they have all fallen from above......	397	ditto
	N. B. The *Brahmins* say, they never heard of any rock or place called the cows-mouth or *Gao muc'h*, or any thing like it, either in sound or signification.—We did not see or hear of any image whatever.		
4	River flows under a snow bed; a rill of water from the snow to right. High precipices on both sides, all the way	278	88

		Paces.	Degrees.
5	Alternate avalanches of snow and rock recently fallen.—River under an avalanche of 500 feet thick, the snow hard and frozen	900	80
6	In rocky bed of the river. Ascend a rock 35 feet high by climbing. River much confined, and the fall great	485	80
7	A great fall of the peaks.—River bed filled with fallen rocks, and difficult to pass.—The stream, a succession of cataracts. High peaks above	691	80
8	Over fragments. Here the river falls out of a snow bed, in a cascade of foam: ascend the great snow bed	500	ditto
9	Strong ascent of the snow bed, which is about 100 feet thick, over the river	221	80
	Cascades of the river. Pass through masses of rock, difficult to climb: precipices above	1000	90 60 15
11	Cross a torrent 6 feet wide and 9 inches deep; it comes from a cleft in the peaks to the left. River here under a snow bed; from last station is a rocky path	969	82
12	River turns the foot of high snowy peaks to the right: precipices quite perpendicular to the left.—*Rudra Himalaya* peak 97	853	82
13	Finding that the head of the river must be more distant than we expected, we sent back to *Gangotrí* for a small tent	50	103
14	High mural precipices rising immediately from the river		

		Paces.	Degrees.
	to the left: snowy peaks to the right, their summits about 6000 feet above us	340	110
15	Cross the river at some falls. We leaped from rock to rock with some difficulty.—Large rill to right: present general line of snow about 200 feet above us.—To the right, the face of the mountain has slipped	110	315
16	*Bhojpatra* (i. e. birch) *jungle* to the right with some pines, but small and stunted.—Great mural precipices to the left	808	110
17	Begin to pass a great *snow bed*, from under which the river falls in a cascade.—Heavy slips of the mountain to the right	924	ditto
18	Ascend a very steep mass of snow, which covers the river; it appears to be 300 feet thick.	340	360
19	Cross a rill.—To the right above us, are sharp snowy peaks 6 or 7000 feet high, at their bases is some soil, and loose stones, in which birch and small firs grow	752	110
20	Up the rocky bed of the river, and here ascend a very *large snow bed*, which reaches from the top of the peaks to the right to the river, and conceals it: the river bed here more expanded. The feet of the mountains to the right not so steep as hitherto. To the left are precipices. Saw some musk deer among		

				Paces.	Degrees.
the rocks.—From the top of the snow bed, a noble					
snowy peak (St. George) appears, bearing	132°	38′	5″		
Altitude................	10	40	5		
A snow peak behind us, distant about 20 miles,					
bears....................................	284	24			
Altitude................	3	02		1478	ditto
Total Paces				12,220	

ABOVE the left bank of the river, and by the side of the snow bed, are some birch trees and small long leaved firs, but no more cedars.—This being the only convenient or safe place we could see, we halted here. The river is perceptibly diminished in bulk already, and we hope that to-morrow we may see its head.—The march to-day was most toilsome and rough through the loose fragments of rock which daily fall at this season from the peaks on either side to the river, in the afternoon, when the sun melts the snow.—Travellers should contrive to gain a safe place by noon, or they may be dashed to pieces.

IT was very cold at this place, and froze all night, but we had plenty of firewood from the *Bhojpatra* trees.—The soil was spungy, and full of rocks.—The silence of the night was several times broken by the noise of the falling of distant avalanches.

BY the barometer, it appeared, we were 11,160 feet above the sea.—Water boiled at 193° of Fahrenheit.

A LITTLE tent, which one man carries on his back, came to us; but in this trip, we eat and slept on the ground, and were well pleased to have got so far beyond *Gangotrí*, hitherto the boundary of research on the *Ganges*.

Latitude observed........30° 58′ 59″

THE place we passed the night on is elevated above the left margin of the stream, being a sort of bank formed by the ruins of fallen peaks; but as the falls are not recent, nor the slope so steep, as in most places, the birch trees and various sorts of small pines and mosses have had time to fix their roots, and afford fuel and shelter.—A very long and deep snow avalanche reaches from the peaks above the left bank, down to the river, and conceals it. On the opposite side of the river, the cliffs are of great height and mural, except in one place where a tremendous fall has taken place, encumbering and obstructing the bed of the river. But these ruins are so frequent, that the traveller scrambles through them with little regard, except where the freshness of the fracture of the fallen masses of rock warns him to mend his pace, and get as soon as possible out of danger.

May 30th. Birch Tree, Halting place, forward. Ther. Sun rise, 32°

Set off from the middle of the snow bed.

		Paces.	Brg. from N. Degrees.
1	A torrent 8 feet wide, 5 inches deep, joins the river. Its edges are frozen..................................	328	133°

Paces. Degrees.

2 Cross a high avalanche of snow, which conceals the river; it is very hard frozen. The bed of the river begins to be wider; large isicles hang among the rocks 903 ditto

3 Ford a rivulet or torrent from the left 11 feet wide. Rocky and rough.—Gradual ascent..................2412 ditto

4 Gradually ascending among rocks. To the left high cliffs of granite, but not so steep as before. To the right snowy peaks, their summits about 6 or 7000 feet high, distant about 2 miles. The river bed is here about 2 furlongs wide, and full of stones. River certainly diminished in size; it is very rapid, its bed being an ascent. We are now above the line of vegetation of trees, and past the last firs.—The birches remain, but they are only large bushes; laurels also are seen, and a sort of, I believe, *litchen*, which grows in the rocks.—The noble 3 peaked snowy mountain shines in our front, and is the grandest and most splendid object the eye of man ever beheld. As no person knows these peaks or their names, we assume the privilege of navigators, and call them St. George, St. Patrick, and St. Andrew: St. George bears 129, St. Patrick 132 30.

N. B. On going further, we saw another lower peak between St. George and St. Patrick, which we called St. David, and the mountain collectively, the 4 Saints.

5 A fall of the river of 12 feet over rocks, and a succession of smaller falls.—The inclination of the bed of the

		Paces.	Degrees.
	river is considerable; it is filled with blocks of granite, white, yellow, and red, and we saw some flint. Very difficult moving here.—Great slips of the mountain to the left..........	980	132°
6	Most difficult.—Over masses of rock, which have fallen from above to the stream.—This station is full of peril, being a very recent slip of the whole face of the mountain to the left.—The broken summits cannot be less than 4000 feet high; blocks threaten to fall, and are indeed now continually coming down: I have not seen so dangerous a slip.—The ruin extends about half a mile; every person made the greatest haste to get past this horrid place. The fracture of the rocks is so fresh, that I suspect this havoc must have been caused by the earthquake of the 26th, for we heard a great crash in this direction..........	1352	132 to 140
7	Over snow for the most part. An enormously high and extensive snow bed in sight, in front: it entirely conceals the river, but the stream is yet 20 feet wide....	615	180
8	Snow all round, and above and below, except where it has melted just here, on a convenient flat, between the river and the feet of the mountains to the left.—All beyond is an inclined bed of snow, as far as the eye can see, and there is no firewood; so we must halt here.—Call it halting place, near the *Debouche* of the *Ganges*	447	130
	Proceeded forward to reconnoitre, and returned..........	1034	

	Paces	Degrees.
9 Up the river, and along snow.—Mount *Moira* 170, pyramid peak 200	8071	
Return to ⊙, 8 to halt for the sake of firewood. Deduct	1034	
	7037	

THIS is an excellent and safe place; no peak can fall on us; 5 companies, or even a battalion, might encamp here.—Sublime beyond description is the appearance of the snowy peaks now so close to us. The 4 Saints are at the head of the valley of snow, and a most magnificent peak, cased in snow and shining ice, stands like a giant to the right of the valley: this we named mount *Moira*. The snow valley, which hides the river, appears of great extent; to-morrow will shew what it is.

WE experienced considerable difficulty in breathing, and that peculiar sensation which is always felt at great elevations, where there is any sort of herbage, though I never experienced the like on the naked snow beds, even when higher.—Mountaineers, who knows nothing of the thinness of the air, attribute the faintness to the exhalations from noxious plants, and I believe they are right, for a sickening effluvium was given out by them here, as well as on the heights under the snowy peaks, which I passed over last year above the *Setlej*; though on the highest snow, the faintness was not complained of, but only an inability to go far without stopping to take breath.

BAROMETER.—The tube heated, and then gradually filled with mercury, half an inch at a time, and the bubbles which were perceptible driven out by gently beating against the places they were seen at:

The mercury stood at ....18. 854 Inches

Detached thermometer.....55°

Attached ditto.........53

Height of the place above the level of the sea 12,914 feet.

Water boils at 192¼°; which, according to Mr. KIRWAN's table, answers to a barometer of 19. 5. In.

WE are about 150 feet above the bed of the river. By day the sun is powerful, although we are so surrounded by snow; but the peaks reflect the rays.—When the sun sunk behind the mountains, it was very cold; at night it froze. High as we are, the clouds yet rise higher.—The colour of the sky is a deep blue.—What soil there is, is spungy.—A few birch bushes are yet seen; but a large and strong ground tree or creeper over spreads the ground, somewhat in the manner of furze or brambles; and it is a curious fact that the wood of this, is, we think, that of which the cases of black lead pencils are made, being of a fine brittle, yet soft red grain; and the smell is the same as of that used for the pencils, and which has hitherto been called by us cedar. I have specimens of this wood; it is called, I think, *Chundun*: I saw it on the summit of the *Chour* peak, and in the snowy regions of *Kunaur*, but did not then examine it.—It will be found, probably, that the *Pinus Cedrus* or *Cedar of Lebanon* is the *Deodar* (or as it is called to the Westward, the *Kailou*), and no other.—Nor do our mountain cedars (24 feet in circumference) yield in size or durability;

to those of Lebanon. But this *Chandan* (miscalled Cedar) is not even a tree; it may be called a large creeper, growing in the manner of bushes, though it is very strong, and some of its arms are as thick as a man's thigh:—of this, and also of the great Cedar (*Deodar*), and of other pines, I will send specimens.

Latitude.

Lieutenant HERBERT.—5 observations, by Sextant, of Meridian Altitude, Pole Star, and β minoris....	30°	56′	37″.5	
My observations, reflecting circle, reversed faces, M. Alt. Polaris....................................	0	0	32.5	
Mean...........	30	56	31	5

All good observations.—The particulars of them, as well as of all others, I have preserved.

The strata of rock, (where exposed), near the summits of the grand snowy peaks, was very nearly horizontal, as I observed it to be, last year, at the summits of the peaks above the *Setlej;* though in lower parts of the *Himálaya,* it is generally seen deeply declined, as observed between *Dangul* and *Sookie,* as well as at *Jumnotri,* &c.

THE colour of the high rocks on the four Saints, appeared to be of a light yellow mixed with brown or black. There being a small piece of level ground here, a primary base was measured on its longest extent; it was 319 feet; with it a longer base of 667.2 feet was obtained, favorably

situated for taking the heights and distances of the peaks in front. This base, being but short, and no other to be had, great care was taken in observing the angles and elevations; and they were repeated both with a fine theodolite, and reflecting instruments, (my circular instrument could not be safely brought beyond *Reital*). The angle of altitude of peak St. George was 14 07

	feet	
Its height above the present station	9326	6
The station above the sea, according to the barometer	12,914	
Height of the peak above the sea, feet..	22,240	6

Distance of St. George 38,240 feet

Latitude............. 30° 52′ 29″ 1

Bearing, corrected for variation, is 132° 20′ or 42° 20″ S. of E.

St. Patrick, height above the station............	9471	0
Station above the sea	12,914	

Distance 42,480 feet, and height above the sea, feet 22,385

Latitude........30° 51′ 35″ 8

Corrected bearing S. of East 46° 44′

A sharp peak across the river;—call it the pyramid; angle of elevation taken with reflecting circle, corrected for the distance of the eye, to the mercury .... 32° 57′ 9″

Height of the peak above the station	8,052
Station above the sea	12,914
Height above the sea .... feet	20,966

Distance.............................14,800 feet.
Latitude...............................30° $54'$ $46''$ 7
Correct bearing........................77° 00 S. of E. or 167°

A ROCK on the great snowy bed, over which we are to pass, proved to be distant 9044 feet, and its height above this place 984 feet, the angle of elevation being 6° $15'$, which is the general inclination of the snow bed; as our progress was continued far beyond this rock, it will easily be imagined that the crest or summit of the bed, *then distant* 5 or more miles by estimation, must have a very considerable elevation.

WE had brought very few followers onwards from *Gangotrí*, but here we sent back every one we could possibly dispense with, that our small stock of grain might subsist the remainder, who were a few trusty fellows (*Musulmans*), 2 *Gorc'ha Sipáhís*, and a few *Coolies*, for two days or three if possible, in the event of our being able to get over the snow in front. And I sent orders to the people at *Gangotrí* to leave grain there, if they had any to spare, and if they did not hear of any supply coming from *Reital*, to make the best of their way back till they met it, and then to halt for us, and send some on to us.—Having made all the arrangements we could, on the important head of supplies, and made observations, we had leisure to admire the very singular scenery around us, of which it is impossible to give an adequate description.

THE dazzling brilliancy of the snow was rendered more striking by its contrast with the dark blue colour of the sky, which is caused by

the thinness of the air; and at night, the stars shone with a lustre, which they have not in a denser atmosphere; it was curious too, to see them, when rising, appear like one sudden flash, as they emerged from behind the bright snowy summits close to us, and their disappearance, when setting behind the peaks, was as sudden as we generally observed it to be in their occultations by the moon.

WE were surrounded by gigantic peaks, entirely cased in snow, and almost beyond the regions of animal and vegetable life, and an awful silence prevailed, except when broken by the thundering peals of falling avalanches; nothing met our eyes, resembling the scenery in the haunts of men; by moonlight, all appeared cold, wild, and stupendous, and a Pagan might aptly imagine the place a fit abode for demons.—We did not see even bears, or musk deer, or eagles, or any living creature, except some small birds.

To form an idea of the imposing appearance of a snowy peak, as seen here under an angle of elevation of nearly 33°, and when its distance is not quite 3 miles, and yet its height is 8052 feet above the station, one should reflect, that if even when viewed from the plains of *Hindustan*, at angles of elevation of one, and one and a half degrees, these peaks, towering over many intermediate ranges of mountains, inspire the mind with ideas of their grandeur, even at so great a distance; how much more must they do so, when their whole bulk, cased in snow from the base to the summit, at once fills the eye.—It falls to the lot of few to contemplate so magnificent an object, as a snow clad peak rising to the height of

upwards of a mile and a half, at the short horizontal distance of only 2¾ miles.

May 31st. From halting place, forward.

		Paces.	Degrees.
1	Along, and above the right bank of the river, rocks and snow	1445	133
2	Descent to the bed of the river, enclosed by rocks	864	193
3	A most wonderful scene.—The *B'hágirat'hí* or *Ganges* issues from under a very low arch at the foot of the grand snow bed—The river is here bounded to the right and left by high snow and rocks; but in front, over the *Debouche*, the mass of snow is perfectly perpendicular, and from the bed of the stream to the summit, we estimate the thickness at little less than 300 feet of solid frozen snow, probably the accumulation of ages;—it is in layers of some feet thick, each seemingly the remains of a fall of a separate year. From the brow of this curious wall of snow, and immediately above the outlet of the stream, large and hoary icicles depend; they are formed by the freezing of the melted snow water of the top of the bed, for in the middle of the day, the sun is powerful, and the water produced by its action falls over this place, in cascade, but is frozen at night.—The *Gangotri Brahmin* who came with us, and who is only an	511	140

Paces. Distances.

illiterate mountaineer, observed, that he thought these icicles must be MAHÁDÉVA's hair, from whence, as he understood, it is written in the *Shástra*, the *Ganges* flows.—I mention this, thinking it a good idea, but the man had never heard of such a place, as actually existing, nor had he, or any other person to his knowledge, ever been here.—In modern times they may not, but *Hindus* of Research may formerly have been here, and if so, I cannot think of any place to which they might more aptly give the name of a Cow's Mouth, than to this extraordinary *Debouche*.—The height of the arch of snow is only sufficient to let the stream flow under it. Blocks of snow were falling about us, so there was little time to do more here, than to measure the size of the stream.—Measured by a chain, the mean breadth was 27 feet.—The greatest depth at that place being knee deep, or 18 inches, but more generally a foot deep, and rather less just at the edges, say 9 or 10 inches.—however, call the mean depth 15 inches.—Believing this to be, (as I have every reason to suppose it is), the first appearance of the famous and true *Ganges* in day light, saluted her with a Bugle march, and proceeded, (having to turn a little back to gain an oblique path), to the top of the snow bed; having ascended it, to the left.

4 Pretty strong ascent up to the inclined bed of snow. This vast collection of snow is about 1½ miles in width, filling up the whole space between the feet of the peaks to the right and left; we can see its surface forward to the extent of 4 or 5 miles or more, to where its it bounded, on the left, by the feet of the 4 Saints, and to the right, by snow spurs from other mountains beyond mount Moira: these last spurs rather overtop the feet of the Saints, and to them, and to the place where we judge there is a ridge, is all ascent over snow.—Pyramid peak 236°—Mount Moira 180°—St. George 129°—St. Andrew 136°.............. 1400 144

5 Ascent of the same kind—generally acclivity 7°, but we pass over small hollows in the snow, caused by its irregular subsiding.—A very dangerous place; the snow stuck full of rubbish, and rocks imbedded in it.—Many rents in the snow appear to have been recently made, their sides shrinking and falling in. A man sunk into the snow, and was got out not without some delay. The bed of the *Ganges* is to the right, but quite concealed by the snow .... 509 do.

In high hope of getting on to what may be at the top of the acclivity, we have come on cheerily over the hollow and treacherous compound of snow and rubbish, but now with bitter regret, we both agree that to go on is impossible! The sun is melting the snow

	Paces.	Degrees.
on all sides, and its surface will not bear us any longer. I have sunk up to my neck, as well as others. The surface is more and more ragged, and broken into chasms, rifts, and ravines of snow with steep sides.—Ponds of water form in the bottoms of these, and the large and deep pools at the bottoms of the snow hollows, and which were in the earlier part of the day frozen, are now liquid. It is evident, from the falling in of the sides of the rents in the snow, that there are hollows below, and that we stand on a treacherous foundation.—It is one o'clock, and the scene full of anxiety and awe. The avalanches fall from mount Moira with the noise of thunder, and we fear our unsteady support may be shaken by the shocks, and that we may sink with it. St. George 130° 45′ altitude 17° 49′ Pyramid 255 33 do. 26′ 49 Inclination of the snow bed about 7°, what appears the highest part of snow bed, ahead 155°—Altitude 7°. No time to take more	1427	155
	6156	

AND here we were obliged to return! Had it been possible to have got across the chasms in the snow, we would have made every exertion,

so anxious were we to get forward; but onward, their sides were so steep, and they appeared of such great depth, that I do not think it would be possible to pass them, (this year at least), even if the snow was not, as at this hour, soft, and the bottoms of the chasms filling with water. Be that as it may, they are now utterly impassable. At this season snow must fall here, whenever it rains below, so that it does not acquire such hardness on the top, as it does on the avalanches we have hitherto passed, where no new snow at present falls.—We now set out on our return, and not too soon, as we found, for the snow was so soft, and the increase of the water so great, that though we went with the most possible expedition, it was only by 2½ hours hard labour of wading, and floundering in the snow, and scrambling among rocks, where they would give a footing, that we reached the turf, tired and bruised with falls, and the skin taken off from our faces and hands by the sun and drying wind of these elevated regions.

It now remains to give some account of this bed or valley of snow, which gives rise to the *Ganges*. It appears that we passed up it, some what more than a mile and a half.—From our last station, we could see onwards, as we estimated, about 5 miles, to where there seemed to be a crest or ridge of considerable elevation, though low when compared with the great peak which flanked it; the general slope of the surface of the snow valley was 7°, which was the angle of elevation of the crest, while that of the peak St. George, one of those which flanked it to the left, was 17° 49.—In the space we had passed over the snow bed, the *Ganges* was not to be seen; it was concealed, probably, many hundred feet below the sur-

face; we had a fair view onward, and there was no sign of the river, and I am firmly convinced that its *first appearance in day* is at the *debouche* I have described; perhaps indeed, some of those various chasms and rents in the snow bed, which intersect it in all sort of irregular directions, may occasionally let in the light on some part of the bed of the stream, but the general line and direction of it could only be guessed at, as it is altogether here far below the broken snowy surface.—The breadth of the snow valley or bed is about a mile and a half, and its length may be 6½ or 7 miles from the *debouche* of the river, to the summit of the slope, which terminated our view; as to the depth of the snow, it is impossible to form a correct judgement, but it must be very great.—It may easily be imagined, that a large supply of water is furnished at this season, by the melting of this vast mass in the valley, as well as by the melting of that of the great peaks which bound it. From their bases, torrents rush, which cutting their way under snow, tend to the centre of the valley, and form the young *Ganges*, which is further augmented by the waters which filter through the rents of the snow bed itself.—In this manner, all the *Himálaya* rivers, whose heads I have visited, and passed over, are formed; they all issue in a full stream from under thick beds of snow, and differ from the *Ganges*, inasmuch as their streams are less, and so are their parent snows.—On our return down the snow valley, we passed nearer to its North side than in going up, and saw a very considerable torrent cutting under it from the peaks; this was making its way to the centre; at times, we saw it through rents in the snow, and at others, only heard its noise: as there must be several more such feeders, they will be fully sufficient to form such a stream as we observ-

ed the *Ganges* to be at the *debouche*, in the space of 6 or 7 miles.—I am fully satisfied, that if we could have gone further, that we should not have again seen the river, and that its appearance at MAHÁDÉVA's hair, or whatever we may choose to call it, was the real and first *debouche* of the *B'hágirathí*.—All I regret, is, that we could not go to the ridge, to see what was beyond it. I suspect there must be a descent, but over long and impassable wastes of snow, and not in such a direction as would lead direct to any plains, as the course to bring one to such plains would be to the N. East or North, whereas the line of the rivers course, or rather of the ridge in front, was to the S. East, parallel to the run of the *Himálaya*, which is generally from S. E. to N. W. Immediately in front of the ridge, no peaks were seen, but on its S E. flank, and at the distance of about 18 miles, a large snowy peak appeared, so that I think there can be no plains within a considerable distance of the S. E. side of the ridge: if there be streams from its other side, they must flow to the S. East.—After all, I do not know how we should have existed, if we had been able to go to the ridge, for we could not have arrived there before night, and to pass the night on these extensive snows, without firewood or shelter, would have cost some of us our lives, but of that we did not then consider much, (if we could have gone, we would). We had only a few trusty men with us, and a short allowance of grain for them, for this and the following day, and had sent orders to the people left at *Gangotri*, to make their way back towards *Reital*, leaving us what grain could be spared, and to forward on what they might meet, as I expected some from *Reital*, from whence we were supplied during our absence from it, of altogether 28 days.—I cannot suppose that by

this way, there can be any practicable or useful pass to the *Tartarian* districts, or doubtless the people would have found it out, and used it, as they do that up the course of the *Jáhnavi.* While I give it as my opinion, that, under any circumstances, the crossing of the ridge must be difficult, I would by no means wish to be understood to assert, that I think it impossible, under more favorable circumstances, and in a year when less snow has fallen than in the present; but I seriously declare, that situated as we were, it was not possible for us to go further than we did, and that it was with great difficulty we got back.

IT is now to be considered, if the supplies of water, produced as above described, are sufficient to form a stream of 27 feet wide, and 15 inches (mean depth) at the *debouche.*—It has been stated, that at *Gangotrí*, the breadth of the river on the 20th May, was 43 feet, and its depth 18 inches.—The distance thence to the *debouche* was 22,620 paces, which I reckon about 11 *British* miles. In that space, it received some supplies, as mentioned in the notes, but they were not abundant.—Thus the quantity of water is diminished nearly one half; but it is to be remembered, that on our return to *Gangotrí*, on the 2d June, the bulk of the river was considered as being doubled, it being 2 feet deep, and also much wider, so that on the 31st May, we may suppose it to have been 21 inches deep, and perhaps 48 feet wide at *Gangotrí*. It is with this mean size, that the comparison of the difference of its bulk at *Gangotrí*, and the *debouche*, must be made; the proportion thus is, that the body or quantity of water would be at *Gangotrí* almost treble to that at the *debouche*; but allowing it to be only double, in this 11 miles, it will be evident, that in 5 or 6 miles further, there can be little

or no water in the bed, under the snow, and, consequently, that the most remote rill, which contributes under the snow, to the first formation of the *Ganges*, cannot be more distant than the ridge; so I think it may be allowed, that such first formation is on the hither side of the ridge, and not at any lake, or more distant place beyond it.

INDEED, considering the large supplies which the snow valley furnishes, I rather wonder that the stream was not larger, when I measured it at the *debouche*.—Whether there are any boiling springs under the snow, as at *Jumnotri*, I do not know, but suppose there are not, as I did not see any smoke; a steam, however, there may be, and the steam may be condensed ere it can appear.—I imagine, that the season of the rains would be, in one respect, the most proper to attempt the passage of the great snow bed; it may at that time be reduced in thickness, but I have no idea that it ever melts away; yet, in the rains, it perhaps will not be possible to ford the river above *Gangotrí*, which must frequently be done, if the smaller avalanches, on which we very frequently crossed it, are melted. In the rains also, there must be greater hazard from the falling of the rocks, and slips of the mountain, for the melting snow forms many rills, which undermine the rocks, and set them loose, and it is not possible to avoid a large fall of the mountains side, if one should unfortunately be in the line of its direction, when it comes down.

I HAVE preserved specimens of the rocks of which these peaks are composed, also of the different sorts of pines which grow at their bases. Above *Suc'hí*, and *Jhala*, the country is not inhabited, nor is it habitable

beyond those places, except at the small village of *Durāli*, which is now deserted.—*Tuwarra*, *Suc'hí*, and *Jhala*, are very small and ruinous villages.—*Reital* is a pretty good village of about 25 houses, as is *Salung*, and there are 2 or 3 more in that neighbourhood.—I found the inhabitants civil and obedient.

THE people of *Rowaen* are, in general, much inferior in appearance to those of *Jubul* and *Sirmour*, and the more western mountains; indeed, with few exceptions, they are an ugly race, both men and women, and extremely dirty in their persons. They complain much of the incursions of the banditti from the western parts of *Rowaen* and *Busahir*, who carry off their sheep in the rains; but, from what I can learn, they in turn plunder their eastern neighbours of the *Cédar-nāt'h* districts, and they pride themselves on the long journeys they make in their sheep stealing expeditions.—The proper time for those forays is the latter end of the rains, when the snow in the defiles is much reduced.—The women have not here, as to the westward, a plurality of husbands. I saw no fire arms among the inhabitants, nor swords or war hatchets; their weapons are bows and arrows.—The climate of *Reital*, is, at this season, very pleasant, and the price of grain is not high, but it is not abundant. —The corn is cut in the beginning of June.

No volcanos were seen or heard of in these mountains, whose composition is granite of various kinds and colours.—No shells or animal remains were seen—The magnetic variation was small, and differing little, if at all, from what it is on the plains of the upper provinces; it is

from 40' to 1° and 2° according to different needles, and is easterly, by which I mean, that the variation must be added to the magnetic azimuth. The diurnal small changes in the barometer were perceptible, the mercury always falling a little before noon, as in the plains.

HAVING received new thermometers from *Calcutta*, both long and short, I found that they gave the same boiling point, but the thermometer I had last year, in *Busahir*, &c. shewed the boiling point 2° or 2¼° below the new ones.—I always suspected the thermometer, but had not then a better. It boiled in the *Panwei* pass in the *Kunaur* and *Busahir* snowy mountains at 188° at my camp a little above the lower line of snow, on the 24th June last, so that it should have been 190°, or 22° lower than at the sea side. Bears abound in the higher mountains, also the *Goorul* or *Boorul*, an animal between the deer and goat, and the *Pheir*, a larger animal of the same kind; I have preserved the skin, horns and bones of the head of one shot near *Jumnotri*. Near the villages, where snow lays a great part of the year, there are abundance of the *Monaul* Pheasants and *Chakors*. In the lower mountains, there are black partridges, and tigers, leopards, and bears. I never saw any snakes in the cooler regions.

IT was remarked above, that the snow on the great bed was stuck as it were with rock and rubbish in such a manner, as that the stones and large pieces of rock are supported in the snow, and sink as it sinks; as they are at such a distance from the peaks, as to preclude the idea that they could have rolled down to their present places, except their

sharp points had been covered, it appears most likely that the very weighty falls of snow, which there must be here, in the winter, bring down with them pieces of rock, in the same manner as a larger snow ball would collect gravel, and carry it on with it in its course.—Masses of snow, falling from the high peaks which bound the snow bed, if they chanced to collect more, and to take a rounded form, would have a prodigious impulse, and might roll to the centre of the snow valley, loaded with the pieces of rock they had involved.

IT is not very easy to account for the deep rents which intersect this snow bed, without supposing it to be full of hollow places.—It struck us, that the late earthquakes might have occasioned some of the rents.—I never saw them before on other snow beds, except at *Jumnotri*, where they are occasioned by the steam of the extensive range of boiling springs there; perhaps, there may be such springs here also; they are frequent in the *Himálaya*, and one might suppose they were a provision of nature to insure a supply of water to the heads of the great rivers, in the winter, when the sun can have little power of melting the snow above those deep recesses.

I WILL now proceed to give some account of the course of the river *Jumna*, within the mountains, and of its spring at *Jumnotri*, which I also visited this year; the above remarks, respecting the *Ganges*, having already swelled this paper to too great a bulk, I will make those, regarding the *Jumna*, in as few words as possible.—In the maps published ten years ago, the *Jumna* is laid down as having a very long course

from the latitude of $34\frac{1}{2}$; from what authority, it is difficult to guess, for much as has been surmised and written respecting the head of the *Ganges*, I cannot find any accounts of that of the *Jumna*.—It was not known, until the year 1814, that the *Jumna*, properly so called, was a comparatively small river above its junction with the *Tonse* in the *Dún*, and I believe the existence of the latter river, though fully treble the size of the *Jumna*, was unknown to *Europeans*.

THE junction of the *Tonse* and *Jumna* takes place at the N. W. end of the *Dún* valley, in latitude 30° 30′, where the large river loses its name in that of the small one, and the united stream is called the *Jumna*. The course of the *Jumna* from *Jumnotri*, which is in latitude 30° 59′, being generally south 50° west. It is fordable above the confluence, but the *Tonse* is not.—Not having yet visited the sources of the *Tonse*, I am not certain whether it rises within the *Himálaya*, as the *B'hágirathí* does, or at its S. W. or exterior base like the *Jumna*; but the latter I believe to be the case. I apprehend, that three considerable streams, which, like the *Jumna*, originate from the south faces of the *Himálaya*, in the districts of *Barasa*, *Leulowari*, and *Deodara Kowarra*, join to form the *Tonse*; and it receives a considerable accession of water from the *Paber* river, which I imagine to be equal in size to any of the three above-mentioned feeders. Respecting them, I have at present only native information to guide me, but of the *Paber* I can speak with more confidence, for, when in June 1816, I penetrated within the *Himálaya*, by the course of the *Setlej*, I found that the north bases of many of the snowy peaks, seen from the plains of *Hindustan*, were washed by that river.—Its

course, in the province of *Kunaur*, in latitude 31° 31′, and longitude 78° 18′ being from east 25 S. to 25 to the N. of west. In this position, the *Setlej* is bounded both to the N. and S. by high and rugged snowy mountains, from which many torrents descend, and increase its bulk.—Leaving the left bank, and bed of the river, I ascended the snowy range, of which it washes the north base, and crossed over it on the 21st June 1816, at 40 minutes past 11 o'clock, in the forenoon, during a heavy fall of snow, being the first *European* who effected a passage over the grand *Himálaya* ridge in that direction.

On surmounting the crest of the pass, I found that the *Indravatí* river, which is a principal branch of the *Paber*, originated from the snows, on which I descended, on the S. W. or hither side of the ridge; and I followed its channel, to the place where it joins the *Paber*, which river must have its beginning, in like manner, on the same side of the ridge, as I was informed by the people of the country it had, and I am nearly certain it is the case; and it is most probable, that all the streams which form the *Tonse*, do, in like manner, descend from the south west side of the fronting snowy range, the north east base of which is washed by the *Setlej*, as above mentioned.

However, I intend to explore the sources of the *Tonse*, as well as of the *Setlej*, and *Jáhnaví* rivers.—But to return to the *Jumna*.

The route from its confluence with the *Tonse*, in the *Dún*, is thus;—to *Calsí* four miles,—a large village immediately within the mountain of

Jáunsar, of which district it is esteemed the capital.—It is situated between two high and steep mountains, and on the *Omla*, a small river which joins the *Jumna.*—*Calsí* is a place of some little trade, as the people of the neighbouring mountains bring to it their productions, and exchange them for cash to pay their rents, and a very small quantity of the produce of the plains.—On the march, the *Jumna* is forded above its confluence with the *Tonse*. Carriage cattle may go to *Calsí*, but further within the mountains, every article is carried on men's backs.—Latitude of *Calsí* 30° 31′ 24″.

Calsí, to Bairat Fort.

Total distance 24,511 paces.

6000 paces of exceedingly steep ascent of the mountain, on left bank of the *Omla*;—2300 easier, to the village of *Khuny* on the ridge; remainder, along the mountains side, with occasional ascents and descents, to the foot of the peak of *Birat*, which rises conically above the ridge;—1800 paces of the steep ascent up it to the fort, which is a small double enclosure.—It was abandoned by the *Gorc'ha* garrison, on the approach of a force under Colonel CARPENTER.

THE height of *Birat* above *Scharanpur*, (which is visible from it), is 6508 feet; it commands a noble view of the snowy mountains, and the various intermediate ranges, as well as of the *Dún* valley, and the plains on both sides of the *Jumna*.

INVALIDS from the plains, requiring a change of climate, may find it at

Birat.—In the winter, the fort is almost buried in snow, which remains in shady places, and on the northern side of the peak, till the beginning of April; but snow seldom falls later than the last week of March, at which season, while I was in the fort, there was a shower which covered the ground to the depth of 2 inches:—the peak is a bare slaty rock, with some quartz intermixed.

29*th March,* 1817.—*Birat to Murlang.*

Total distance $4^{m}. 6^{f}$.—$2^{m}. 5^{f}$, narrow path along the mountain's side, then a steep descent of $2^{m}. 1^{f}$ to *Murlang*, a small village in a glen, on the *Silgad* rivulet, which falls into the *Jumna* three miles to the east.—No grain here.

Lat. observed 30° 36′ 53″.

Thermometer at noon 78°. It was yesterday, at noon, at *Birat* 50°.

30*th March.*—*Murlang to Cot'ha.*

Total distance $9^{m}. 5^{f}$.—Proceed 2½ miles down the bed of the *Silgad* to the *Jumna*,—then leave it, and cross a ridge, and go up the bed of the *Jumna*, to the confluence of the *Cunti* river, which joins it from the *Keinah* peak to the west.—That river is about 60 feet wide, and 1½ and 2 feet deep. The *Jumna* is 90 feet wide, 3 to 5 feet deep, rapid, and not fordable.—The rest of the path is a long ascent of the mountain, above the right bank of the *Jumna*, to *Cot'ha*, a village of 10 houses, about 3000 feet above the level of the river.—A fatiguing march,—heavy rain,—no grain here.

31*st March.*—*Cot'ha to Lakha Mand'al.*

Total distance $8^{m}. 7^{f}$.—For $6^{m}. 7^{f}$, the path lies generally along the side

of the mountain, with occasional strong ascents and descents; 1^{m}. 5^{f}. of very steep descent into a dell, the rest lighter descent, flat and ascent from a rivulet to *Lak'ha Mańd́al*, on the right bank of the *Jumna*, and about 300 feet above it.

Lak'ha Mańd́al is a place of some celebrity, in *Hindu* story, as having been one of the temporary residences of the *Pańd́us;* and tradition says, that formerly there were a great number of statues and temples here, but I imagine the greater part to have been buried by the slip of the side of the mountain, at the foot of which it is situated.—Several pieces of cornices, entablatures, and other ornamental fragments of buildings, are seen projecting above the soil, which buries the remainder; they are of black stone, and the carving of the ornaments is very well executed. There are also two statues of BHÍM and ARJUN, of the size of life, which are half buried in the soil; and a prodigious number of small idols are deposited in a little temple, which is the only one now remaining, and which does not appear to be of any remote antiquity.—The ignorant *Brahman* could give no account of the builder; he declared, as they all do, when consulted on such subjects, that it is not of human workmanship, but was built by BHÍM, countless ages ago.

IT does not appear that pilgrims now resort here; the place is nearly desolate; it is surrounded by high rocky peaks, and may have been chosen as a fit seat for gloomy and recluse superstition.

WITHIN the temple, there is a large slab of blue stone, inscribed with

Hindu characters; I cleaned it, and took off a reversed impression, as well as circumstances would allow, and sent it to Colonel MACKENZIE.

Latitude of *Lak'ha Man'd'al* 30° 43' 24".

Lak'ha Man'd'al, to Bancaulí.

Distance 3.m 5.f—Gradual descent 1½ miles to the *Ricnar* river, which is the boundary between *Sirmor*, and the *Rewaen* district of *Gurhwal.*—It has a course of about 10 miles from the N. W. and joins the *Jumna* here.—From the river, a very strong ascent of 1¼ mile up the mountain, to a crest called *Gén'd'a Ghát'*; three obliquing to *Bancaulí*, a village of 20 houses, with a temple;—it is on the mountain's side, and about 3000 feet above the *Jumna*.—No grain to be had here, as at other places;—I planted potatoes. Rainy weather;—no latitude.

3d April, 1817.—*Bancaulí, to Paunti.*

Total distance 11.m 1f by the wheel; in paces 23,108.—To the bed of the *Jumna* 3.m 3f mostly oblique descent, though steep in some places above the right bank of the river. Here are very high and steep precipices, from which large blocks of granite have fallen into the bed of the river, which forces its way through and over those obstructions with much violence and noise. After passing over the rocks by the river side for half a mile, we leave it, and climb the right bank, by an exceedingly steep ascent, to the *Tocm Ghát'i*, which overhangs the stream, and is about 1000 feet above it.—Hence, descend a mile to the *Camaulda* river; cross it on trunks of trees laid across, a little above it's junction with the *Jumna*.

THE *Camaulda* is the largest river which the *Jumna* receives above the confluence of the *Tonse*; its course is from N. 10° west, down the *Ráma Serái* district, which is a small valley, and is reported to be in some places a mile wide, but it is now overrun with *jungles*, full of wild beasts.—The *Camaulda*, now swollen by the rain, is about 70 feet wide, and 2½ feet deep, and very rapid. Immediately on crossing it, the country up the *Jumna* assumes a more pleasing appearance; the mountains which bound it, though very lofty, do not rise so abruptly, and several small villages are seen on their lower slopes. On the right bank of the river, there is a slip of level ground 3 to 500 yards wide.—The summits of the mountains are covered by cedars and other pines, and the snow yet lies on them. Proceed by the river side to *Pauntí*, a village of 20 houses, pleasantly situated about 400 feet above the *Jumna*.—The march was long and fatiguing, as it rained the whole way; the loaded people did not arrive till after dark.—At this village, I got supplies of grain.—The country I have passed through from *Calsí* is nearly deserted, on account of famine, caused by the crops of last year having been destroyed by the hail, in October.—Aware of this circumstance, I have brought grain with me from *Calsí*, and subsisted my followers with it.

Latitude of *Pauntí* 30° 48′ 08″.

5th April, 1817.—*Pauntí*, *to Gíra*.

Total distance 7.ᵐ 1½.ᶠ—2¼ miles parallel to the *Jumna*, and descend to its bed, where the stream from the *Banaul* glen joins it.—Leave the *Jumna*, and proceed three miles N. W. up the *Banaul* river.—Then ascend the south face of the mountain to *Gíra*, a village of 10 large

houses pleasantly situated, and sheltered from the northern blasts. This district of *Banaul* is about seven miles in length; the N. W. end is closed by a high rocky mountain, where the stream arises, which waters the bottom of the glen.—Several villages are seen placed in advantageous situations on the sides of the mountains, the soil of which is fertile; wood, water, and grain are abundant.

As I learnt that much snow yet remained on my route forward, I halted here some days, to give it time to melt, and to refresh my people, who were harrassed by the journey from *Calsí*, for it had rained every day, and they had been sparingly and ill fed, and also to take the rates of my chronometers.—I took two immersions of Jupiter's satellites, as follows:

		H.	M.	S.	
9th April,—2d Sat.	Observed immersion at mean time	14	41	55	5
	The same was observed, at the *Madras* observatory, at..............	14	49	35	8
	Differences of the meridians		07	40	3
	Longitude of *Madras*..............	5	21	14	
	Ditto of *Gíra*	5	13	33	7

The observations, at both places, are noted as clear and good.

10th April,—1st Sat. Observed immersion, but not a good

observation, mean time	14	09	27	
Same at *Madras* observatory	14	17	25	4
		07	58	4
	5	21	14	
Longitude by 1st Sat.	5	13	15	6
Ditto ...... 2d ditto		13	33	7
	H.	M.	S.	
Mean by immersions	5	13	24	6
Latitude of *Gíra* .... 30°	52'	03"		

12th April, 1817.—*Gíra, to Thánno.*

Total distance 8 miles.—Down the N. side of the glen, and pass through the villages of *Bisút* and *Déváli*, to *Dakiát*, a large village, 4. 6.—Proceed parallel to the *Jumna*, but above it, 1. 6, and descend to the *Badál* river, which comes from a glen similar to that of *Banál*, but is longer, and contains more and larger villages.

THE river joins the *Jumna* here; it comes from the *Cédára Cánta*, a large mountain covered with snow, and its course is from N. 15° west; breadth about 40 feet, depth 1½ and 2 feet. Proceed 1½ miles further to *Thánno*, a small village, 400 feet above the right bank of the *Jumna*.

THE road to-day, chiefly on a gradual descent; path, good and pleasant.—The *Jumnotri* snowy peaks, seen up the river, have a noble appearance; the eastern peak bears $56^{\circ}\ 17'$ N. E:—its altitude $8^{\circ}\ 16'$.

Thánno appears to be 4083 feet above the level of *Seharanpur*.

Latitude observed $30^{\circ}\ 49'\ 12''$.

13*th April*, 1817.—*Thánno, to Catnaur.*

Total distance $4^{m}.\ 2^{f}$.—Steep descent to the *Jumna*, and cross it on a *Sangha*, which consists of three small spars and some twigs bound together, and laid across in the manner of a hurdle.—The *Sangha* is in two portions, being laid from rock to rock; one is nine paces in length, and the other seven, the breadth of the river being about 40 feet; but it is deep, being confined between the rocks, through which it falls like a cataract. The water nearly touches the bridge, which is a bad one.—Some of my goats fell through it, and were drowned.—Above this place, the bed of the *Jumna* is much inclined; the stream bounds from rock to rock, and, for the most part, is a series of small cataracts.

A mile beyond the *Sangha*, cross the *Sílba*, a small river from the glen of that name, and proceed to *Catnaur*, a small village 500 feet above the left bank of the *Jumna*; up the *Sílba* glen is a convenient pass over the ridge, which separates the *Ganges* and *Jumna*.

THE path to-day chiefly ascent and descent, and very rough and steep in most places; and hence, forward, the features of the mountains bear a harsher appearance, there being generally mural precipices rising

from the bed of the *Jumna* to the height of 1500 to 2000 feet, either on one side or the other.—The summits of the mountains all round, are deep in snow.—A stream from a peak called *Dallia Cursu*, joins the *Jumna* here, from the S. E.

Latitude observed 30° 51′ 35″.

As no grain was to be had here, I was obliged to march, in the afternoon, to a very large village called *Páli*, situated up a wild glen; this was a good deal out of my route.—The inhabitants of *Páli*, and the neighbouring villages, have been noted for a rebellious spirit against both the *Gur'hwál*, and *Gorc'ha* governments.—They had cut off several parties of the *Rája's* troops, and surprized and destroyed a complete company of *Gorc'has*, several years ago, for which they were punished by a force sent against them under the brave chief *B'hacti T'hápa*. On my arrival, they refused to sell me any supplies, and I expected to have had trouble.—However, towards evening, we came to a better understanding, and I got abundance of grain.—The village consists of about fifty large houses; the inhabitants are stout and hard featured, and the women generally have light complexions, and agreeable countenances.—In the morning, I went down the glen 1¼ miles, and then along the right bank of the *Jumna*, but high above it, by a difficult and very unpleasant pathway overhanging it; in one place, I was obliged to go with great caution, and bare footed, for a false step would be fatal.—The precipices, on the opposite side of the river, are quite perpendicular, and on this, exceedingly steep. After passing the worst part, descend to *Oj'ha Ghur*, a hamlet of three huts only, in a dismal situation, at the feet of steep and lofty cliffs,—

the rocks hurled from which, by the earthquake of 1803, buried a small fort and village, which once stood here:—dreadful mementos are seen in these mountains, of the effects of that catastrophe. Under *Oj'ha Ghur*, a stream falls into the *Jumna*, and several cataracts are seen falling among the surrounding precipices.—There are some hot springs at the bed of the *Jumna*, which is 400 feet below the hamlet.

Latitude observed 30° 54′ 47″.

15*th April*, 1817.—*Oj'ha Ghur, to Ráná.*

Total distance 4ᵐ. 5ᶠ—In paces 91,815.

2655 paces along the mountain's side, and descent to the *Jumna*.—Cross it on a *Sangha* of 2 small spars; its length 20 feet, breadth about 2½ feet.—The river rushes with great violence under the *Sangha*, and nearly touches it.—The general breadth of the stream is greater, but it is here confined between two rocks.

1200 paces, by the margin of the river; the rest, for the most part, ascent, and in some places very steep and rugged.

Ráná is a small village of 15 houses, about 800 feet above the left bank of the river, on the slope of the mountain;—the general lower line of snow on it, does not appear to be more than 1000 feet above the village. The opposite bank of the river is composed of yellow granite precipices, rising murally from the stream to the height of about 2500 feet, or more.—The courses of the rocks are disposed almost horizontally, as high as 1000 feet above the river; but, towards the

summits, they appear to incline in an angle of about 35°, the apex being to the south west.—Heavy storms of hail and thunder.

16th *April*, 1817.—*Ráná*, to *Bannása.*

Distance 7839 paces.

ASCENTS and descents to the small village of *Bárí*, 2356 paces;—684 paces further descent to the *Burhá Gangá* river, which has a course of about 8 miles from the snows to the right; it is in 2 streams, each 8 paces wide, and 18 inches deep, and joins the *Jumna*;—1480 paces of exceedingly steep ascent; the remainder, ascents and descents, and difficult road.—Cross the *Jumna* on a *Sanghá*, and also the *Bannása* river, which is about two thirds of its size, and joins it here.—Ascent to *Bannása*, a small village, at the foot of a rocky mountain, a fall from which, last year, destroyed half the village. Angle of altitude of the mountain 40° 55—Among the cliffs, and on the summit, I observed, with a telescope, many of a species of animal, peculiar to these elevated regions; it is called *Pheir*, and as a mountaineer in my service succeeded after many toilsome chaces in shooting one of them, I can give a description of its dimensions.

	feet	inches
Length, from the tip of the nose to end of the tail; the length of the face being 11 inches, and of the tail 3 inches only.....	5	0
Height, from shoulder to toe	3	2½
Girth, at the chest	2	11½
Do. at the loins.	2	4

Length of the hair at the shoulders, 8 inches, but on the other parts of the body, it is short.

I preserved the skin and the bones of the head and horns, and presented them to the MOST NOBLE THE GOVERNOR GENERAL, who, I believe, sent them to Sir JOSEPH BANKS.

THE face of the animal, which was a male, resembles that of the *Níl Gáo.*—The horns are large, the lower part of them stands nearly erect from the forehead, but the upper half bends backward. The hoofs, cloven.—The colour, that of a camel or lion, and the long hair about the shoulders and neck, somewhat resembles a lion's mane.—The flesh appeared coarse, and an unpleasant musky smell exhaled from it. The *Hindustánís* would not touch it, but the *Gorc'ha sipáhís*, and mountaineer *Coolies*, eat it with avidity. It is remarkable, that those people will not eat mutton. The *Pheir* is a gregarious animal, and appears to subsist on the short herbage at the edge of the snow.—The chace of it, in its haunts on the cliffs and precipices, is most difficult and dangerous; but, in the depth of winter, when the snow drives them down to the villages, the people hunt and kill them more easily.

IN this neighbourhood, springs of hot water are very numerous; they are seen bubbling up among the rocks in various places near the rivers.—The heat of the water is too great to bear the hand in it for many moments; but, having broken my long scaled thermometer, I could not ascertain its precise temperature.—The water has little if any taste.—About half a mile above its junction with the *Jumna*, the *Bunnása* river falls from a precipice of yellow and rose coloured granite, of 80 or 90 feet high, in a noble cascade.—The breadth of the stream is about 15 feet,

and it falls into a deep basin, which it has worn in the rock, with much noise.

THE stream is caused by the melting of the snows on the heights above.

FROM the village, two of the *Jumnotri* peaks appear towering above the clouds, with sublime effect. Angle of altitude, (taken by reflection in mercury), of the east peak 15° 34′ 45″, of the west 17° 10′ 10″.

16*th April*, 1817.—*Bannása.*

	H.	M.	S.	
Observed immersion of the 2d Satellite, M. T.	17	16	05	
The same took place at *Madras* observatory, at	17	23	31	1
Difference		07	26	1
Longitude of *Madras*....	5	21	14	
Do. of *Bannása*	5	13	47	9

THE beginning of twilight made the observation not so good as it would have otherwise been.

Latitude observed 30° 55′ 50″.

THIS is not a good latitude. The weather was cloudy and stormy, with showers of sleet.

17th April, 1817.—*Bannása, to Curśálí.*

Thermometer at sunrise 33°.

Descend to the *Jumna*, and cross it on a plank 12½ feet long, and again on a plank of 10 feet;—depth of the water 2½ feet;—beds of frozen snow extend to the margin of the stream. A most laborious and steep ascent of 675 paces, whence gradually descend, and cross the *Jumna* on a small *Sangha*, where it receives the *Imri* rivulet from the snow, whence it originates, about 1½ mile to the end. It is less than the *Jumna*, which is now reduced to the rank of a rivulet. Strong ascent to the village of *Curśálí.*

Total distance 4978 paces.

STORMY weather and very cold, driving showers of sleet and rain; path, bad and slippery.

THE village of *Curśálí* contains about 25 substantial houses, and is situated at the immediate feet of the *Jumnotri* snowy peaks; but they are not visible, as the near and steep part of the base obstructs the view.—The situation of *Curśálí* is very peculiar, and one would hardly suppose that people should choose to live in such a remote and cold place. It is the latter end of April, and yet, daily slight showers of snow fall, and the remains of drifts yet lie in shaded places in the village.—By the sides of the *Imri* and *Jumna*, there are several spots of flat ground, on which the inhabitants cultivate grain enough for their subsistence.—To the west, north, and east, this little secluded place is bounded by the lofty cliffs of the *Himálaya;* and to the south, it is sheltered by a mountain, the north

face of which is not so steep, and it is clothed with trees.—All those are at present deep in snow, which reaches down to the level of the two streams;—yet I found the place by no means an uncomfortable abode, for the heights near it, shelter it from the violence of the winds.—The sun is pleasantly warm in the middle of the day, and the progress of vegetation is rapid, in proportion to the length of the winter.—The rocky and snowy defile called *Jumnotri*, where the *Jumna* originates, is seen in the direction of N. 42° east,—Distant 3 miles.

Latitude of *Cursali* 30° 57′ 19″.

	H	M	S
17th April, observed immersion of Jupiter's 1st satellite, mean time	16	03	46

It appears, no observation was obtained at *Madras*, on this day.

During three days, I attempted to get some sets of lunar distances, and also transits of the moon over the meridian, but was constantly prevented, by clouds, from doing any thing satisfactorily.

21*st April*, 1817.—*Curśáli*, *to Jumnotri*.

1	Flat, along the village fields; here climb a steep rocky corner, above the river's bed. *Jumnotri* nearly 41° 30′—*Chíá* mountain, over which there is a pass to *Suc'hí* on the *Ganges*, practicable in the rains, (at present it is blocked up by deep snow), 128° 30′	0	3	40
2	Steep descent through snow 1 to 5 feet deep, then flat	0	0	148

		m	f	yards
3	Fields—Slight acclivity, snow patches;—abundance of pheasants here, chiefly of the kind called *Monál*	0	0	64
4	Rough and rocky:—descend to the *Jumna*, which in several places flows under beds of snow 25 or 30 feet thick.—An overhanging precipice to right.—A torrent, called the *Bandiali*, ½ the size of the *Jumna*, joins it from a cleft in the rock, and is the last tribute it receives.—The path to this station, entirely through snow:—cross the river twice, once on the stones, and once on a snow arch.............	0	6	143
5	At *Bhairo Ghátí*—The crest of one of the steepest ascents, (for its length), I ever saw; it is entirely up the snow, in which we cut steps with *P'haoras* (spades) to facilitate our passage.—There is here a place dedicated to *Bhairo Lál*, who is esteemed to be the *Janitor* of *Jumnotri*, and *Gangotri*.—It is nothing more than a low building (if it may be so called) of 3 feet high, containing some small iron tridents.—I hung a new English silver coin by a copper ring on one of them......................	0	1	25
6	Exceedingly steep descent to the *Jumna*, by steps cut in the snow.—A cascade of the stream cuts through the snow, and falls from a rock of the height of about 50 feet..........................	0	0	130
7	Stiff ascent up the snow bed, which conceals the river. Except here, where the stream is visible for			

		m	f	yards
	a few yards through a hole in the snow, the snow bed is about 100 yards wide, and bounded by high precipices, from which masses of rock of 40 feet in length have recently fallen............	0	3	211
8	River as before, under the snow; here it appears through a deep hole, falling in a cascade from the rock below the snow.—Rocks on both sides, those to the right cased with ice......................	0	1	152
9	*Jumnotri*.—The place so called	0	0	61
	Total miles....	2	7	100

AT *Jumnotri*, the snow which covers and conceals the stream is about 60 yards wide, and is bounded to the right and left by mural precipices of granite; it is 40 feet 5½ inches thick, and has fallen from the precipices above.—In front, at the distance of about 500 yards, part of the base of the great *Jumnotri* mountain rises abruptly, cased in snow and ice, and shutting up and totally terminating the head of this defile, in which the *Jumna* originates.—I was able to measure the thickness of the bed of snow over the stream very exactly, by means of a plumb line let down through one of the holes in it, which are caused by the steam of a great number of boiling springs which are at the border of the *Jumna*.—The snow is very solid, and hard frozen; but we found means to descend through it to the *Jumna*, by an exceedingly steep and narrow dark hole made by the steam, and witnessed a very

extraordinary scene, for which I was indebted to the earliness of the season, and unusual quantity of snow which has fallen this year.— When I got footing at the stream, (here only a large pace wide), it was some time before I could discern any thing, on account of the darkness of the place, made more so by the thick steam; but having some white lights with me, I fired them, and by their glare was able to see and admire the curious domes of snow over head; these are caused by the hot steam melting the snow over it. Some of these excavations are very spacious, resembling vaulted roofs of marble; and the snow, as it melts, falls in showers, like heavy rain, to the stream which appears to owe its origin in a great measure to these supplies. Having only a short scaled thermometer with me, I could not ascertain the precise heat of the spring, but it was too hot to bear the finger in for more than two seconds, and must be near the boiling point.—Rice boils in it, but imperfectly.—The range of springs is very extensive, but I could not visit them all, as the rest are in dark recesses and snow caverns.— The water of them rises up with great ebullition through crevices of the granite rock, and deposits a feruginous sediment, of which I collected some;—it is tasteless, and I did not perceive any peculiar smell. Hot springs are frequent in the *Himálaya*, perhaps they may be a provision of nature, to ensure a supply of water to the heads of the rivers in the winter season, when the sun can have little or no power of melting the snows in those deep defiles.

FROM near this place, the line of the course of the *Jumna* is perceptible downward to near *Lak'ha Mańd́al*, and is 45 [illegible] S. west. It will be

seen by the notes, that from the place called *Bhairo Ghátí*, the bed of the river is overlaid with snow to the depth of from 15 to 40 feet, except at one or two places, where it shews itself through deep holes in the snow.

THE snow bed is bounded to the right and left by mural precipices of light coloured granite;—on some ledges there is a sprinkling of soil, where the *B'hojpatra* bushes grow. The end of this dell or defile is closed, as before observed, by part of the base of the great snowy mountain of *Jumnotri*, and which is visible from the plains. The altitude of the part of the mountain, visible, is 29° 48'; but higher parts are concealed by the lower and nearer. The face of the mountain, which is visible to the height of about 4000 feet, is entirely cased in snow and ice, and very steep.—The foot of the base is distant from the hot springs about 500 yards, and immediately where the ascent becomes abrupt, a small rill is seen falling from a rock, which projects from the snow; it is about 3 feet wide, and shallow, being only a shower of spray produced by the snow now thawing in the sun's rays at noon. Above that, no water whatever is seen; if there were any, it would be visible, as the whole steep base of the mountain is exposed to view, directly in front; consequently, the above rill is the most remote source of the *Jumna*.—At the present season, it was not possible to go to it, as the snow bed was further on impassable, being intersected by rents and chasms, caused by the falling in of the snow, as it melts by the steam of the boiling springs below it.

HERE then is the head of the *Jumna*, on the S. west side of the grand *Himálaya* ridge, differing from the *Ganges*, inasmuch as that river has

the upper part of its course within the *Himálaya*, flowing from the south of east to the north of west; and it is only from *Suc'hí*, where it pierces through the *Himálaya*, that it assumes a course of about south 20° west.

THE fall of the *Jumna*, from *Jumnotri* to the *Dún*, is very considerable.—I regret I had not a good barometer, to ascertain the height of *Jumnotri;* I had with me an empty country made barometer tube, with which I endeavoured to gain an approximate idea on the subject.—Having warmed and well dried the tube, I filled it gradually with mercury, driving out such air bubbles as were visible, and inverted it in a deep cup of quicksilver, taking care not to remove my finger from the orifice, till the lower end of the tube was fairly below the surface of the quicksilver;—the tube was kept in an erect position by means of a plumb line.

THE length of the column was 20·40 Inch, which, corrected for temperature, gives 10,483 feet for the height of *Jumnotri* above the sea, taking 30·04 inches for the level of the sea.

THE above is only a rude experiment, but I had not the means of making a better; the length of the column may be depended on to the 20th part of an inch, I think, but the probable impurity of the mercury may cause an error of 2 or perhaps 300 feet.

Near noon, I took a short set of circum-meridional altitudes of the sun for the latitude, as follows:

	M	S	°	′	″	
Horary angle.....A.—M.	7	19	30	58	59	9
	5	19	0	0	55	2
	1	58	0	0	52	2
P.—M.	0	31	0	0	47	5
	2	51	0	0	55	2
	6	28	0	0	42	6
Mean latitude of the hot springs of *Jumnotri*			30	58	52	1

THE latitude of the small fall or rill, which may more properly be called the head of the *Jumna*, will be 30° 59′ 06″.

HAVING finished my observations by two o'clock, I set out to return; the heat of the sun had then began to melt the snow on the cliffs on both sides, and many rocks and lumps of snow were falling down; this obliged us to run with all speed down the snow bed, to get out of the way of these missiles:—several of the people had narrow escapes from the falling fragments, but no one was struck.

THE inhabitants of *Curśálí* say, that it is 17 years since they had so severe a winter as the last.—At *Jumnotri*, the inclination of the granite rock is from 43° to 45°—from the horizon.—The apex being to the S. W. or towards the plains.

As the season [illegible] not sufficiently advanced to allow of my passing to the *Ganges* by the [illegible] r *Cílsaum* mountains, both of which are

at present impassable from the depth of snow on them, I returned to *Catnaur*, and going up the *Shiálba* glen, crossed the ridge, which divides the two rivers at the *Jackeni Ghát*, and descended by *Bauna*, to *Barahat*, from whence I proceeded up the *Ganges* to *Reital*, and continued my route beyond *Gangotri*, as before mentioned.

I shortly hope to be able to present to the Society, the result of my trigonometrical operations to determine the heights and positions of all the peaks of the *Himálaya*, visible from *Seharanpur*, and also an account of the sources of the *Tonse* and *Jáhnaví* rivers, and of the upper part of the course of the *Setlej*.

ADDENDA.

	feet
Height of the *Sangha* at *Lohari Naig*, above the Sea	7389
Below *Suchi*	7608
Suchi village	8869
Ridge of the mountain on which *Suchi* stands	12,000
Jumnautri	10,849

III.

Latitudes of Places in Hindustan, *and the Northern Mountains; with observations of Longitude in the Mountains, according to Immersions and Emersions of Jupiter's Satellites.*

BY CAPTAIN J. A. HODGSON, 10TH REGT. N. I.

Places.	Latitude.			Province or District.	Remarks.
	°	'	"		
Ludiana	30	5	16	*Serhind*	Center of the *British* cantonment.
Sambda	29	26	2	*Jind*	Village on the road from *Narba* to *Jind*.
Jind	29	16	50	*Ditto*	Camp, 3 furlongs N. W. of the fort. *Jind* is the principal town and residence of the *Sik'h* chief BAG'H SINH.
Caithal	29	48	51	*Caithal*	Camp, 3 furlong S. of the town, which is the principal town and residence of the *Sik'h* chief B[illegible] SINH. It was one of the marches of TAIMUR, on his route from *Samana* to *Delhi*.
Narnaund, (C)	29	18	0	*Huriana*, (*Brit.*)	On the road from *Jind* to *Hansi*. This latitude is by construction.
Hansi	29	4	34	*Ditto*	Flag staff in the fort.
Ditto	29	3	56	*Ditto*	Center of the cantonment.
Hissar, (C)	29	7	48	*Ditto*	S. E. gate of the fort.
Bahauna	29	31	55	*Ditto*	Village.
Futiabad	29	30	3	*Ditto*	House in the fort. *Futiabad* is mentioned in TAIMUR's march.
Irwá, (C)	29	37	0	*Ditto*	At present a village, mentioned in TAIMUR's route.
Danaur	29	31	29	*Sersa*	Col. ADAM's camp at the *j'hil*.
Dandán	29	41	30	*Ditto*	In the *Battei* country. Col. ADAM's camp at a *j'hil*.
Sersa	29	[illegible]	4	*Ditto*	The ancient fort, taken from the *Batteis* by Col. ADAM, but restored. This is also one of TAIMUR's marches.

Places.	Latitude. °	′	″	Province or District.	Remarks.
Rámsh, (C)	29	31	4	*Sersa*	The chief town and residence of the *Battei* chief BAHADUR KHAN, taken by Col. ADAM, but restored. This was one of TAIMUR's marches from *Batnír*.
Batnír	29	34	40	*Batnír*	West face of the fort, now in the possession of the BICANIR *Rájá*—*Batnír* is well known in history, from the extraordinary march made by TAIMUR, across part of the desert to attack it. It is on the east verge of the great sandy desert, which extends to the *Indus*, and is in longitude 74° 12′ E. nearly. In ARROWSMITH's map, *Batnír* is also called *Batinda*, which is a large town nearly 100 miles from it.
Tushám	28	51	37	*Hariana*	Camp, 400 yards N. E. of the conical peak of rock.
Tigrána	28	51	36	*Ditto*	N. verge of the village, which is a large one.
B'hawání, (great)	28	46	12	*Ditto*	NANDA's tomb—*B'hawání* was stormed and carried by the troops under Colonel BALL. It is a large walled village, 3 miles in circumference.
Birí	28	40	15	*Ditto*	S. side of *Birí*, a very large walled village.
Silán	28	54	56	*Ditto*	S. W. side of the village, which is a large one.
Carár	28	49	27	*Ditto*	Large village, walled S. W. side.
Rhotac	28	53	15	*Ditto*	Center of the town.
Mahim	28	56	55	*Ditto*	Large mosque, west end of the town.
Mund'ahal	29	0	0	*Ditto*	The fort—*Mund'ahal* is a village between *Mahim* and *Hansi*.
Carcara	28	54	20	*Ditto*	S. side of the village between *Mahim* and *Rhotac*.
Bissaien	28	42	13	*Ditto*	Small village near *Birí*.
Nigána	28	45	56	*Ditto*	Large village N. side.
Callowie	28	56	19	*Ditto*	N. end of the *j'hil*, under the village.
Galauli	28	28	15	*Doab*	Fort in Lieut. Col. SKINNER's *júgír*, on the *Hindun* river.
Tilhar	27	56	13	*Rohilk'hand*	*Mango tope* at the S. E. end of the town, which is large.
Shahjehanpur	27	51	17	*Ditto*	Camp, 1 mile east of the N. end of the city, which is very large, and equal or superior to *Bareilly*.
Bareilly, (irregular cavalry cantonment)	28	23	56·5	*Ditto*	Cantonment of Col. GARDNER's cavalry, 2 miles N. of the old fort, at the west end of the city.
Murádábád, (cantonment)	28	50	20·3	*Ditto*	200 yards in the rear of the center of the cantonment.

Places.	Latitude. °	′	″	Province or District.	Remarks.
Chandausi	28	27	37 ·5	*Rohilk'hand*	At Mr. BOLDERO's *Bungalow*, from whence the N. E. gate of the town of *Chandausi* is distant 1 mile 6 furlongs, and bears 44° S. W.
Rámnagar	28	22	28	*Ditto*	North wall of the ancient and extensive PÁ'N'DU's fort—The conical mound, (in height 70 feet), distant 411 yards S. 20 E. The circuit of this old fort, now in ruins, is exactly 4 miles, and it had 34 brick bastions.
Cás ípur, (the factory)	29	11	55	*Ditto*	The government's factory in the old fort, which was extensive, and resembling that at *Rámnagar*. At the N. W. end of the town, and distant from this 1 m. 7 f. is another fort, of which Mr. BURROW observed the latitude.
Habloa	29	15	59	*Ditto*	One furlong west of the town.
Banhera	29	32	3	*Ditto*	1½ furlongs east of the village.
Nagina	29	26	49	*Ditto*	2 furlongs S. E. of the town, on the *Murádábád* road.
Dhampur	29	17	13	*Ditto*	5 furlongs S. E. of the town, on the *Murádábád* road.
Sheohara	29	13	19	*Ditto*	1 furlong S. of S. W. end of the town.
Burhia	27	50	41	*Oude*	4 furlongs N. E. of the village, on the road to *Sítápur*.
Mahauli	27	40	8	*Ditto*	Camp, 1 mile east 20° S. of the village, on the *Sítápur* road.
Sítápur, (cantonment)	27	35	36 ·1	*Ditto*	*Bungalow* on the left bank of the *nulla*, 2d line from the rear.
Pírnagar	27	25	28 ·5	*Ditto*	S. W. end of the bridge, road from *Sítápur* to *Lucnow*.
Barreh	27	16	9 ·3	*Ditto*	A *dergah* at the N. end of the town.
Mohan	27	5	26 ·7	*Ditto*	1 furlong N. W. of the town.
Lucnow, (cantonment)	26	54	50 ·5	*Ditto*	Center of the rear of the *Sipáhis'* lines of the right battalion.
Lucnow, (city)	26	51	50 ·1	*Ditto*	Capt. MACLEOD's house, near the residency.
Salar gunj	26	52	23	*Ditto*	N. gate of the *gunj*, on the road from *Lucnow* to *Bairam ghát*.
Bairám ghát, (cant.)	27	7	26 ·5	*Ditto*	Captain RAPER's *Bungalow*.
Muhammedpur	27	13	12	*Ditto*	S. E. corner of the town, on the road from *Bairam ghát* to *Sítápur*.
Biswa	27	23	16	*Ditto*	Tank at the S. E. end of the town.
Nowil gunj	27	47	40	*Ditto*	The *Serái* in the town. This is the road from *Lucnow* to *Futigerh*.
Bangermow	26	52	53 ·5	*Ditto*	The west end of the town; distant 6 furlongs N. 40 E.
Nanamow	26	52	21 ·5	*Doab*	The ferry, right bank of the *Ganges*, and 200 yards above the old mound of a fort.
Khoda gunj	27	11	31	*Ditto*	The *Serái* in the villages.

Places.	Latitude. °	'	"	Province or District.	Remarks.
Futigerh, (cantonment) ..					
Furkhúbád	27	23	56	*Doab*	Outside the *Delhi* gate, and 3 furlongs N. W. of it.
Ghuria	27	28	33	*Ditto*	Village, right bank of the *Ganges*, in the *Cadir*.
Beitah	27	34	10	*Ditto*	Village in the *Cadir* of the *Ganges*.
Ahmed gunj	27	34	57	*Ditto*	*Gunj* in the *Cadir*.
Bawalpur	27	41	10	*Ditto*	Village in the *Cadir*.
Kidderpur	27	48	0	*Ditto*	Ditto ditto,
Suhawuhur	27	47	40	*Ditto*	N. W. side of the town, distant 1½ furlongs.
Lohia	27	34	27	*Ditto*	The old *gerhi*.
Ita	27	24	15	*Ditto*	*Tope*, 2 furlongs S. E. of the town.
Nindauti	27	34	4	*Ditto*	The large *gunj*.
Sukeit	27	26	41	*Ditto*	N. W. angle of fort.
Awa	27	27	45	*Ditto*	*Tope*, 4 furlongs west of HÍRA SINH'S formidable fort.
Jalésar	27	29	14 5	*Ditto*	At the *Idgah*, 3 furlongs N. W. of the HATRAS's gate of the town.
Saidabad	27	26	54	*Ditto*	1 furlong N. W. of the fort.
Rai	27	33	24	*Ditto*	Large village, 6 miles from *Muttra*.
Barauli	28	5	37	*Ditto*	Large village.
Shicarpur	28	16	38	*Ditto*	N. side of the place.
Abdulpur	28	49	40	*Ditto*	Village on the road from *Meerat* to *Pureitchut ghur*.
Daulheri	28	56	15	*Ditto*	Village on the road from *Meerat* to *Baghput*.
Baroad	29	5	33	*Ditto*	Small walled town in *Bégum* SUMROO'S *jágír*.
Sirdanna	29	8	16	*Ditto*	*Bégum* SUMROO'S house.
Burhanna	29	18	10	*Ditto*	4 furlongs N. 10° west of the town, *Bégum's jágír*.
Kinauni	29	27	21 ·5	*Ditto*	2 furlongs N. E. of the village, *Bégum's jágír*.
Muzaffernagar	29	28	40	*Doab*, district *Seharunpur*	2 furlongs N. E. end of the town.
Nasírpur	29	44	14 ·7	*Ditto*	Village on the road from *Muzafferpur* to *Hurdwar*.
Jaurasi	29	49	2 ·1	*Ditto*	Ditto.
Deobhund	29	40	52 ·5	*Ditto*	West side of the town, the large old brick fort distant 4 furlongs N. 60 E.
Rámpur	29	48	9 ·7	*Ditto*	Camp—The mosque in the town, 4 furlongs S. W. on the road from *Seharunpur* to *Delhi*.
Sarun	29	15	39 ·5	*Ditto*	At a *dergáh*, 1½ furlongs S. E. of the village, *Bégum's* district.
Rámpur	29	16	4	*Ditto*	1 furlong S. E. of the village, *Bégum's* district.
Ghur Mukhteser ghát ..	28	49	33 ·7	*Doab*, district *Meerat* ..	The ferry on the right bank of the *Ganges*.
Camaruddin nagar	28	56	33 5	*Ditto*	West side of the village in the *Cadir* of the *Ganges*.

Places.	Latitude. °	′	″	*Province & District.*	*Remarks.*
Jaisinhpur	29	2	32	*Doab*, district *Meerat*	Village on the high bank of the *Ganges*.
Barámohána	29	7	20	*Ditto*	Small old town N. W. side.
Daurala	29	7	30	*Ditto*	Village on the road from *Meerat* to *Seharanpur*—1 furlong S. of it. Windy, bad observation.
Meerat, (cantonment)	29	1	7	*Ditto*	Horse artillery lines—Dr. PHILLIPS' house.
Hastinápur	29	9	56	*Ditto*	Scite of part of the ancient city, mentioned in history, as having been once the capital of *Hindustan*. It stood on the right high bank of the *Ganges*, and has probably been swept away by the river.
Dháránagar, (ferry)	29	16	48 ·1	*Ditto*	At the ferry, right bank of the *Ganges*, opposite *Dháránagar*.—The mosque there bears 76° 40′ N. E.
Katauli, (town)	29	17	3	*Ditto*	The north gate of the town, distant 3 furlongs N. E.
Jansét, (town)	29	19	57	*Ditto*	N. E. gate of the town.—This was once the seat of the famous *Saiyads* of *Bára*.
Dárhiwala, (village)	29	25	29	*Ditto*	Village in the *Cadir* of the *Ganges*.
Suchatál	29	28	54 ·1	*Ditto*, *Seharanpur*	East gate of the large intrenched camp of ZA'BITA KHAN, on the right high old bank of the *Ganges*.
Bihárí, (village)	29	23	49	*Ditto*	Village between *Jansét* and *Museffernagar*.
Nagal, (village)	29	49	25	*Ditto*	Village between *Deoband'h* and *Seharanpur*.
Sik'hpura, (small old town)	29	54	46	*Ditto*	Ditto ditto.
Seharanpur, (cantonment)	29	59	1	*Ditto*	The left Sergeant's *bungalow* of the infantry lines, distant 1½ furlongs 66 N. E.
Mangtur, (town)	29	47	33	*Ditto*	The old brick fort, distant 5 furlongs S. 70 W.
Toghalpur, (village)	29	36	13	*Ditto*	East side of the village, on the high old right bank of the *Ganges*.
Firozpur	29	29	31	*Ditto*	Small fort and village above *Suchatál*. At this place, it is supposed, TAIMUR crossed the *Ganges*.
Badshapur, (village)	29	40	22	*Ditto*	Village and small fort in the *Cadir* of the *Ganges*.
Lálpur	29	43	53 ·3	*Ditto*	Village in the *Cadir*.
Loksir	29	45	25	*Ditto*	Ditto ditto.
Jwálapur, (town)	29	54	52	*Ditto*	1 furlongs east of the town.
B'hojpur	29	46	52	*Ditto*	Village and fort, right bank of the *Ganges*.
Goverd'hanpur	29	41	49	*Ditto*	Large village and small fort in the *Cadir* of the *Ganges*.

Places.	Latitude. °	'	"	Province & District.	Remarks.
Raiwala, (village)	30	0	44	*Dún* valley, within the first range of hills. The *Dún*, since the conquest, is attached to *Seharanpur*.	Brink of the rapid, right bank of the *Ganges*.
Lak'ha ghát', (ferry)	30	3	42	*Dún*	Right bank of the *Ganges*. This is the highest ferry on the river.
Dêhra	30	19	11	*Ditto*	Gate of the temple.
Kelicpur	30	5	32	*Doab—Seharanpur*	Small village on the road from *Seharanpur* to *Dêhra*.
Keri	30	3	9	*Ditto*	Large village between *Seharanpur* and *Dêhra*. A well at E. end of the village.
Jeberhera	29	48	7	*Ditto*	2 furlongs N. of the town wall. Bad observation.
Rajapur	30	0	1	*Ditto*	Village between *Daulutpur* and *Bhít*.
Faizabad	30	20	16 ·3	*Ditto*	Mosque at the village on the left bank of the *Jumna*, 6 furlongs S. of the ruins of the Emperor SHAH JEHAN's hunting palace or *Padsha-mahal*, at the foot of the south range of hills, where the *Jumna* issues from them, as the *Ganges* opposite does at *Hardwar*.
Bur'hia ghát	30	6	9	*Ditto*	The ferry, left bank of the *Jumna*.
Raipur	30	13	44	*Ditto*	Large village on the old canal from the *Padsha-mahal*, to *Laung* opposite *Delhi*—3 furlongs N. of the village. Bad obervation.
Padsha-bagh	30	20	8	*Ditto*	Halting place, and well at the S. W. mouth of the *Timli* pass through the hills into the *Dún*.
Timli	30	22	36	*Dún* valley	Large village in the *Sál* forest, 1½ furlongs N. of it.
Hoorouwala	30	25	29 ·5	*Ditto*	Large village in the forest, N. side of the valley, on the slope of the *B'hadráj* mountain.
B'hadráj, (camp by the dell, higher on the slope of)	30	25	52	*Ditto*	Forest.
Samspur	30	23	1 ·7	*Ditto*	Village on the *Asun* river.
Ráj ghát	30	24	27	*Ditto*	Ferry on the left bank of the *Jumna*. Indifferent observation.
Kirda	30	27	5	*Sirmur*	Village in the *Kirda Dún* or valley.
Camp	30	31	35	*Ditto*	On the *Macaranda* or *Márcan'da* river, at the foot of the *Nahan* mountain.
Chichcrauli	30	14	50	*Ditto*	Town in the *Sik'h* country, on the road from *Bur'hia* to *Nahan*, belonging to JOD'H SINGH, KULSIA.
Seidpura	30	50	7	*Doab—Seharanpur*	Large village in the *Cadir* of the *Jumna*.
Cun'da ghát	29	44	34	*Ditto*	Ferry, left bank of the *Jumna*, near the village of *Béghi*.

Places.	Latitude. °	'	"	Province & District.	Remarks.
Busera	29	29	51	*Doab—Seharanpur*	
Kairana	29	23	21	*Doab—Meerut*	At a building, in a tope of celebrated *mango* trees, the fruit of which is esteemed to be the best in *Hindustan*, and was appropriated to the use of the emperor. *Kairana* is an old town.
Chaprauli,	29	12	56	*Ditto*	Large village S. W. side of it.
Khas-gunj, (cav. cant.)	27	49	36	*Doab—Coel*	Col. GARDNER's house, 2 miles from *Khas-gunj*.
Sicrole	25	24	17	*Benares*	Mr. BIRD's (the judge's) house near the bridge, at the station of *Sicrole*.
Digga	25	38	28	*Behar—Patna*	Col. GARDNER's house at *Digga*, near *Dinapur*.
Gopipur	23	28	31	*Bengal*, on the *B'hágirathí* branch of the *Ganges*.	4 furlongs S. of the village, which is on the right bank of the river.
					The following observations, on the river to *Dinapur*, in *Tirhut*, and *Chemparan*, are from the means of meridian altitudes of the sun and stars, taken at the same time with reflecting circles, by myself and Captain BARTON, who was appointed my assistant in the survey.
Aghadip, (H)	23	37	12·3 H.	*Ditto*	Left bank of the river, a *mat'h* at S. end of the village, bearing E. 250 yards.
			2·6 B.		
	23	37	7·6		
Bicki Hát'	23	36	28 H.	*Ditto*	Large village on the river, right bank.
			38 B.		
	23	36	33		
Sati	23	58	13·6 B.	*Ditto*	A village on the left bank, bearing W. 20 N. distant 4 furlongs.
Rangamati	24	1	19	*Ditto*	Village on the right bank.
Berhampur	24	5	39	*Ditto*	S. W. corner of the great square of the cantonment. These observations are not good, the weather being cloudy.
Gadhai	24	22	14·1 H.	*Ditto*	Right bank—Village, where the small *Nulla* joins the river.
			16·5 B.		
Place where the navigation of the *B'hágirathí* opened from the main river, in November 1814.	24	38	28·2 H.	*Ditto*	4 furlongs N. of the sandy point, round which, boats now turn from the *B'hágirathí* into the great *Ganges*.
			25·7		
Sivajpur	24	50	51	*Beng.* on the river *Ganges*.	Remains of a village on the left bank of the river, near the ruins of *Gaur*. The *Cadam Resúl* there 68 N. E. distant about 3½ miles.
			48·5		
	24	50	49·7		

Places.	Latitude. °	′	″	Province & District.	Remarks.
Madhupur	25	7	55	*Bengal*, on the river *Ganges*.	Village on the right bank. *Ráj-mahal* point E. 56 S. Windy, bad observation.
Right bank of the river, near *Motijerna* cascade	25	12	51	Ditto	The note of the bearing of the cascade is mislaid, but must be nearly west. Barometer 29, 94—Ther. 74.
Gangápersád	25	15	31 ·2 H. 27 ·3 B.	Ditto	Under the village, and high right bank of the river. The high hill over *Teria galí* bearing west 0° 40′ north.
Sicri gali, (B.)	25	14 15 14	56·5 1 ·3 58 ·9	Ditto	SAIYAD AHMED's tomb on the top of the hill, right bank.
Near *Colgong*	25	16	33 H. 38 B.	Ditto	Right bank. The indigo planter's white house, distant 200 yards E. Large house on the hill 217°. Tree on the lower rock 232°. (S. 52 E.)
Bhagalpur or *Boglipur*	25	15	18 ·5 H. 9 ·1 B.	Ditto	The temple of MAHA'DE'VA on the right bank of the arms of the *Ganges*, which flows under *Boglipur*, and nearly in the center of the town.
(Mean)............			13 ·8		
Deriapur..............	25	22 23 22	52 ·6 H. 1 ·5 57 ·5	*Behar*, on the *Ganges*	Town, right bank of the *Ganges*. The *Byar* creek, which leaves the *Gan'd'aca* river at *Karnaul*, in *Tirhut*, joins the *Ganges*, across the river, due east.
Moar..................	25	25	41	Ditto	Village, right bank. Indifferent observation.
Fetwa...................	25	30	34 ·8 H. 24 ·5 B.	Ditto	Town on the right bank. The mouth of the *Pompon* river 3¼ furlongs W. 10 N. The *math* 150 yards E. 20 S.
Dinapur, (cantonment)...	25	38	12	Ditto	Flag staff 1¼ furlongs, bears S. 40 E. Bar. 30, 03.—Ther. 68.
Seerpur, (ferry)........	25	40	8	Ditto	The ferry, where Major General MARLEY's division crossed. Flag staff at *Dinapur* 116°. *Seerpur* 187°. Here we leave the *Ganges*, and proceed with the army to the *Népál* frontier.
Camp, above the left bank,	25	40	15 ·7 H. 19 B. 17 ·3	Ditto	Head quarters, 29th November.
Mirzapur, (camp near)..	25	48	6 ·6	*Behar*................	5 furlongs N. W. of the village, on the *Mai Nulla*, a creek from the *Gan'd'aca*.
Amnaul................	25	59	28 ·9 38 ·1 33 ·6	Ditto	Large village.—Camp—The village distant 1m 3 furlongs, and S. 30 east.
Camp, left bank of the *Gan'd'ac*........	26	4	18 ·2	Ditto *Tirhut*	11 furlongs above *Fulipur* ferry. Breadth of the *Gan'd'ac* here, 530 yards.

Places.	Latitude. °	'	"		Province & District.	Remarks.
Camp near *Goora*	26	8	47·4 12·4		*Behar—Tirhut*	Camp, 5 furlongs N. E. of the village on the *Byar* creek.
			11·8			
Chynpur	26	15	10·1 5·1	H. B.	*Ditto*	Camp, 9 furlongs N. 14° west of the village.
Bridge of boats over the *Bur'ha Gan'd ac* river	26	24	21·9 26	H. B.	*Ditto*	Camp, near the village of *Cálhara*, distant 7 furlongs N. 83° E. on the left bank of the little or old *Gan'dac*, which is called higher up the *Sikrana* river. At the bridge, the river was 93 yards wide, and 6 to 9 feet deep.
Camp near *Mejauli*	26	30	13 22	H. B.	*Ditto*	Camp, on the left bank of the *Bukia* river, near the village. Not good observations, on account of the camp smoke.
Ducca	26	40	51 23	H. B.	*Ditto*	Camp, 2 furlongs N. 15 east of the village. These 2 sights differ 28" which is more than usual; but in a large camp, observations are liable to be hurt by the smoke, and the trampling of men and cattle.
Gorasén	26	49	37·7 26·2	H. B.	*Ditto*	Camp, left bank of the *Bukia*, opposite side to *Gorasén*. Tolerable observation, but much smoke.
Camp near *Jitpur*	26	48	8·7 13·5	H. B.	*Behar—Chemparan* (In the *Terái*)	Camp between the *Jumni* river, and *Tír-nulla*. Village of *Jitpur*, distant 6 furlongs, W. 56 N.
	26	48	11·1			
Lowten, (camp)	27	1	6·4 4·7	H. B.	*Ditto*	The *Bukwia-nulla* is on the right flank of the camp, and the fort *Barchgerhi* is distant 2ᵐ 1ᶠ E. 8° S. This latitude is the mean of various observations of the sun and stars.
	27	1	5·5			
Alown, (camp)	27	2	5 16·3	H. B.	*Ditto*	Camp, on the left bank of the *Berha* river. Ruins of the small fort of *Alown* (across the *Berha*) 3 furlongs, and east 50 S. At this camp, Captain SIBLEY, and the artillery men killed at *Persa*, were buried.
	27	2	10·6			
Amerpati, (camp)	26	59	41·5 41·6		*Ditto*	Camp, on the left bank of the *Gaad* river, near the hamlet of *Amerpati*.
			41·51			
Mohan, (camp)	27	5	40 33		*Ditto*	Left bank of the *Gaad* river. The small village of *Mohan* 310°
	27	5	36·5			
Belhai, (camp)	26	59	37 29	H. B.	*Ditto*	The small village of *Belhai*, distant 5 furlongs, bearing 217°.

Places.	Latitude. °	'	"		Province & District.	Remarks.
Baura, (camp)	27	2	19·8	H.	*Behar—Chemparan* (In the *Terái*)	At the large tank or *pokra*, on the right of the line. This was the *Népál* boundary.
		2	8·6	B.		
	27	2	14·2			
Bettiah	26	47	56·8	H.	*Ditto*	Tent near the south gate of the town, distant 340 yards N. 65 E. the *Rájá's* house 66°, 20′. The town wall 348′ to 78°. Mean of crossed observations of the Sun's Rigel and Sirius.
			47·5	B.		
	26	47	52·1			
Berherwa, (camp)	27	3	23·2		*Ditto*	Camp of the division near the small village of *Berherwa* in the *Terái*.
			8·4			
	27	3	15·8			
Banjari pokra, (camp)	27	2	29·2	H. & B.		Camp of the division, the left flank on the large tank, and the right on a deep small *nulla*; a strong position.
Korberwa	26	54	5·5		*Ditto*	Tank near the village, 10 miles from *Banjari pokra*, on the *Sigauli* road.
Sinhásani	26	50	51		*Ditto*	Tent at the *Berga* tree, on the south side of the village.
Sigauli	26	45	31·8		*Ditto*	2 furlongs east of the village.
Bettiah	36	48	14·2		*Ditto*	Tent at the east gate of the town. The *Rájá's* house bearing 284°. Mean of several sets of observations.
Adhapur pokra	26	56	16	H.	*Ditto*	The great tank, where 2 companies had been cantoned.
			3	B.		
	26	56	9·5			
Cachirwa	26	52	44·7	H.	*Ditto*	East side of the village, which is on the *Bukia* river.
		53	3·9	B.		
	26	52	54·3			
Jounkunwa	26	48	22·2	H.	*Ditto*	Large village, 10m 2f from *Cachirwa*, and 2m. 5f. from *Berherwa*, where the *Gorc'ha* post under PARAS'URÁM THÁPA was surprised.
			18·7	B.		
			20·4			
Joapur	26	47	19·9	H.	*Ditto*	Mango *tope*, west of the village
			18·7	B.		
			19·31			
Matiári	26	39	10·4	H.	*Ditto*	Tent at the great *Pákher* tree, at the edge of the *mun* or deep *j'hil*, west side of the village.
			13·7	B.		
Semurie	26	41	43·7	H.	*Ditto*	West side of the village, in the *tope*.
			40·3	B.		
Ticaulia	26	56	24·5	H.	*Ditto*	Mango *tope*, east end of the village.
			23	B.		

Places.	Latitude. °	′	″	Province & District.	Remarks.
Ramnagar	27	10	0·6	H. *Behar—Chemparan*	Mango *tope*, 5 furlongs N. W. of the town of *Ramnagar*, which is a considerable place, and inhabited by the exiled hill *Rájá* of *Tancu*, and his followers.
		9	57	B. (In the *Terái*)	
		9	58·8		
Boggah	27	5	16	*Ditto*	Great tree at S. W. side of the town, which is on the left bank of the *Gan'd'ac* river. Indifferent observation.
Seumeser, (mountain)	27	22	27	*Ditto*	Small fort on the summit of the mountain, which is 2270 feet above the *Terái*, which it divides from the *Chitaun* valley, through which the *Rapti* river flows to the *Gan'd'ac*. If a fort were built by us here, it would at all times ensure a passage from the *Terái* into the above valley.
Tirkelwa	27	0	6	*Ditto*	Village, tent by the side of the *Herher* river.
Gobindgunj	26	28	58	*Ditto*	Large mart and ferry, on the left bank of the *Gan'd'ac* river. At this period, Captain BARTON having left me to join his regiment, the following observations were taken by me alone.
Pippera	26	33	1	*Bettiah*	Mr. GLEGG's indigo factory.
Calyánpur	26	25	58·5	*Ditto*	N. E. end of the village.
Ancient *Hindu* tumulus or mound near *Kisseria*	26	19	28	*Ditto*	3 furlongs from the mound, and S. 39. west of it.
Karnaul	26	16	33	*Tirhut*	5 furlongs east of the town, which is on the *Gan'd ac*.
Motipur	26	15	34	*Ditto*	Mr. WOOD's indigo factory.
Bistaulia	26	10	30	*Ditto*	Large tree near the village.
Sersya	25	2	4	*Ditto*	Indigo factory on the *Byar* creek.
Serrya	25	46	20	*Ditto*	Village, first stage from *Hajipur* towards *Muzafferpur*.
(*On the Ganges from Dinapur to Cawnpore.*)					
Mouth of the *Gogra* or *Dewah* river	25	47	19·5	*Ditto*	Confluence of the great river *Gogra* with the *Ganges* at *Semuria*. The great *Berghet* tree bears 312°, distant 1ᵐ. 1ᶠ. Course of the *Gogra* up 298°, of the *Ganges* 216°.
Noka and *Udown Chepra*	25	40	42	*Ditto*	Great tree at *Noka* and *Udown Chepra*; 2 villages on the left bank. The *Ganges* up 219°, down 85 for 6 furlongs, then 100°. Channel deep.—Bank high.—
Ekauna	25	39	37	*Ditto*	Right bank near *Ekauna*, river up 329° for 1 mile, down 140°.
Anjaurpur	25	41	34	*Ditto*	Village of *Anjaurpur* 296° 3 furlongs on branch of the *Ganges*. Course up 210°.

Places.	Latitude. °	'	"	Province & District.	Remarks.
Buxar, (flag staff in the fort)	25	34	35	*Tirhut*	Right bank of *Ganges*.
Ghazipur	25	33	50	*Ditto*	250 yards below the *Chihelsitún* palace.
Left bank of the *Ganges*	25	30	40	*Ditto*	S. east end of *Ghazipur* cantonment 41°. The *Chihelsitún* 48°, distant about 6 miles.
Zemeria	25	24	47	*Ditto*	Indigo works on the right bank. River up 212° to 235° and 240°.
Left high bank	25	29	45	*Ditto*	*Sahibpur*, N. right bank opposite 230° 7 furlongs, *Nidra* 274°, *Phulwaria* 209°.
Right bank below *Benares*	25	15	54	*Ditto*	Sands—*Surai* village 283°. 3 m. river's course up 282°, down 100°.
Benares	25	17	58	*Ditto*	Sand on the right bank, opposite the city. Center of the dome of the great mosque 13°. 14 *Siváia* temple 230°. 19 — River front bastion of *Ramnagur* 161°. 38.
Chunar	25	7	30	*Ditto*	At the ferry N. of the fort. The flag staff 18°. S. W. corner bastion 83.
Chepur	25	12	17 ·3	*Ditto*	High right bank of the river, under the village of *Chepur*. The large village of *Betauli* distant 1m. 1. f. and bears 116 lower down the river. Many troublesome sands in the river here.
Mirzapur	25	9	43	River *Ganges*	Dr. TURNBULL's house and factory, on the high right bank of the river.
Bijraul	25	16	5	*Ditto*	Under the *Siváia* and village, right bank of the river. At this place is a ledge of *konker* rocks, and a very strong current, dangerous to boats.
Chandni	25	20	55	*Ditto*	High right bank, at the small village of *Chandni*. Highest building in the fort of *Allahabad* 331°. 10.
Serái	25	30	31 ·4	*Oude*	Left bank. *Serái* village 9°. 6 furlongs. *Bungalow* on high point at *Ougenic*, right bank 283°, river up 285°. down 130°.
Subadar ka perwa	25	31	37	*Ditto*	Left bank. *Sinhori* 122°—Stone *ghát* at *Jehanabad* 259, *Busiri* 210. River up 255°.
Palhanna	25	34	24	*Doab*	*Palhanna*, large village with a *Siváia meth*, right bank.
Manicpur	26	46	16	*Oude*	Left bank, below the high old fort.
Dalmow	26	3	58	*Ditto*	Sand on the right bank, upper stone *ghát* in the town across 351°, center *ghát* 9°, lower 81°. Transit of Mercury. The preceding limb of the planet going off, touched the sun's exterior limb, at mean time $22^h\ 15^m\ 44^s$. 40^{th}. 5. 11th November, 1815.

Places.	*Latitude.* °	′	″	*Province & District.*	*Remarks.*
Bilaura	25	53	3	*Doab*	Right bank. *Ghát* at N. E. corner of a large *tope*, 5 furlongs below the town of *Bilaura*.
Buxar	26	8	8	*Ganges—Oude*	The *ghát* at *Buxar*, a large village, left bank. *Surajpur*, lowest white building in the town, 294°, about 4¾ miles.
Cawnpore, (cantonment)	26	28	23	*Doab*	Major MACPHERSON's *bungalow*, formerly the brigade office, near the artillery depot.
(Here, leave the Ganges, and proceed up the Doab to Seharanpur.)					
Chaubépur	26	36	59	*Doab*	S. side of the village.
Pourwa	26	44	26	*Ditto*	2 furlongs N. W. of the village.
Meerun-ci-Serái	27	1	58	*Ditto*	Small *tope*, 1½ furlongs N. W. of the *Serái*.
Jelalabad	27	6	9	*Ditto*	Indigo vats, 1 furlong W. 20 N. of the village.
Khoda gunj	27	11	23	*Ditto*	1½ furlongs N. W. of the *Serái*, on the *Futtiger'h* road.
Futiger'h, (cantonment)	27	21	47	*Ditto*	Large red *bungalow* (2d range from the river); formerly Mr. BUSH's shop.
Arjunpur	27	41	7	*Ditto*	East side of the village.
Khas gunj	27	48	42	*Ditto*	*Îdgah*, 1½ furlongs from the west gate of the town.
Jerrari	27	47	0	*Ditto*	1½ furlongs west of the village.
Coel, (civil station)	27	53	55	*Ditto*	Near the tombs of the officers killed at *Aliger'h*, and one mile N. of the *Delhi* gate of *Coel* city. *Aliger'h* fort distant 2m. 3fur.
Soomna	28	3	16	*Doab—Coel*	Indigo vats, 3 furlongs from the village on *Aliger'h* side.
Koorja	28	15	42	*Ditto*	1 furlong N. of N. E. end of *Koorja*, which is a large old *Saiyad* town.
Gullouti	28	35	37	*Doab—Seharanpur* S. division	N. gate of the village.
Hauper	28	43	28	*Ditto*	Captain HUNTER's house, at N. gate of the town.
Rohanna	29	35	40	*Ditto*—N. division	Pond, N. E. end of the village.
Deobhund	29	42	17	*Ditto*	Old mosque and pond, 4 furlongs N. 30° west of the N. side of the town, on *Seharanpur* road.
Civil station, near *Seharanpur*	29	57	9·5	*Ditto*	House of Mr. GRINDALL, the magistrate, by 61 observations of the sun and stars.

Places.	Latitude. °	′	″	Province & District.	Remarks.
(The following are within the mountains, conquered from the Gorc'has.)					
A'mbár'i	30	28	57	*Dún* valley	Bank of the *Jumna*, east side of the village.
Cálsi	30	31	24	*Jaunsar*	Small town, within the mountains, and between the *Tonse* and *Jumna* rivers.
Runtum	30	31	59	*Ditto*	Small deserted fort on the mountain, above *Cálsi.*
Bairat	30	34	31 ·7	*Ditto*	Fort, on the high peak of the mountain.
Nahan, (the capital of *Sirmor*)	30	33	21	*Sirmor*	Captain WILSON's house.
Jaitac, (fort)	30	35	3	*Ditto*	100 yards N. W. of the fort.
(The following are Latitudes of places in the mountains of Sirmor, Jubal, Keounthul, Comarsén, Bisehcr and Canaur, between the rivers Tonse and Setlej.)					
Shúngrá	30	41	36	*Ditto*	Walnut trees—*Shúngra* is the chief village of the district, on N. face of the mountain, which bounds the *Giri gangá* to the N.
(The following are on the Haripur road to Jubal.)					
Underi	30	42	37	*Ditto*	Large village, side of mountain, *Chaur* peak 7° 10.
Bowai	30	45	7	*Ditto*	Large village, at the foot of one of the S. E. spurs of the *Chaur* mountain.
Culag	30	47	8	*Ditto*	Village and small fort, foot of a S. eastern spur of the *Chaur.*
Cherauli	30	49	17	*Júbal*	Village, between spurs of the *Chaur.*
Ballou	30	51	4	*Ditto*	Small village, N. eastern spurs of the *Chaur.*
Lingjhar	30	53	53	*Ditto*	N. N. E. spur of the *Chaur.*
Choag	30	49	50	*Sirmor*	Village on S. W. spur of the *Chaur*, on the *Mushiur* rivulet, which joins the *Giri gangá.*
Thor	30	46	42	*Ditto*	Small village on the *Giri gangá*, at N. foot of the *Sén-ci-Dhar* mountain.
Dinga Cinga	30	42	7	*Ditto*	Village on the ridge of the *Sén-ci-Dhar* range. Bad observation.
Burj-ci-Téba	30	42	12	*Ditto*	Halting place, near stockade on the *Burj* mountain, which is a continuation of the *Jaitac* range road, *Nahan* to *Sabattu.*

Places.	Latitude. °	'	"	Province & District.	Remarks.
Tilri-ci-Daber	30	49	21	*Bughat*	Halting place, at N. W. foot of the *Burj-ci-Tiba.*
Mia-cá-gaon	30	54	32	*Ditto*	Village between the mountains.
Subattu	30	58	24	*Keounthul*	British cantonment of the 1st *Nuserie* battalion of *Gorc'has.*
Haripur	31	0	53	*Ditto*	Village on the *Gambhír* river, road *Subattu* to *Cot ghur.*
Serie	31	4	51	*Ditto*	Deserted village, on slope of the mountain.
Bunni Chokey	31	5	53	*Ditto*	Halting place, near *Phaghun*, on ridge of the mountain—*Chaur* peak 146° 20
Theog	31	6	45	*Ditto*	On ridge of the mountain, the small fort distant 300 y. 297 f. — *Chaur* high peak 159° 05. *Nagni* fort 118°. The *Giri gangá* about 5000 feet below.
Matiana	31	11	34	*Comarsén*	Village between mountains — *Chaur* high peak 168° 50. *Nagni* 166° 31.
Kundroat	31	14	25	*Ditto*	Village in deep dell, west of the fort on *Wartoo* mountain. *Wartoo* fort 82° 9.
Cot ghur	31	19	29	*Ditto*	British cantonment of the 2d *Nuserie* battalion of *Gorc'has*, on slope of the mountain, about 5000 feet above the left bank of the *Setlej.*
Nirt	31	21	46	*Bischer*	Village on the left shore of the river *Setlej*, which is confined in a narrow bed by steep mountains of rock of great height.
Rámpur	31	26	22 ·7	*Ditto*	*Rampur* is the capital of *Biseher*, and the winter residence of the *Rájá.* It has much fallen to decay, and at present has only about 150 mean houses, and some better, belonging to the *Rájá.* It stands on the left bank of the *Setlej*, which is 210 feet wide, in June very rapid; it is crossed by a rope stretched across to the opposite or *Culau* side. The river is confined by exceedingly steep and lofty mountains of rock. The heat at *Rampur*, is excessive.
Dhar	31	28	53	*Ditto*	Village, left bank of *Setlej*, and about 4000 feet above it.
Muzoulia	31	28	40	*Ditto*	Village on rivulet, and in glen of some name, reaching from the *Setlej* to the snowy peaks.

Places.	Latitude. °	'	"	Province & District.	Remarks.
Seraén	31	30	19	*Bischer*	Walnut tree, near the *Rájá's* house. *Seraén* is about 4500 feet above the *Setlej*, and is the summer residence of the *Rájá;*—a pleasant situation on the mountain side;—it is only a village. The *Rájá's* house is high, and built in the *Chinese* form, as usual in these mountains.
Tranda	31	33	42	*Canaur*	Village, high above the *Setlej*. *Canaur* is that remote and rugged province of *Bischer*, which is within the *Himálaya*, and on the *Setlej* river.
Kungous	31	32	51	*Ditto*	Left bank of *Setlej*, and high above it; the river is confined by mural precipices.
Nichar	31	33	15	*Ditto*	Do. Do.
Boora	31	32	46	*Ditto*	Village, in high glen of the *Suldang* river, which falls from the N. side of the snowy peaks to the *Setlej*. This village, and the others of *Canaur*, are in snow the greater part of the year. Here I turned to S. E. and began the great ascent of the N. face of the S. ridge of the *Himálaya*.
Pass over the Snowy Range	31	29	25	*Ditto*	24th June, 1816. In the snow, and between the cliffs of the *Himálaya*, at the immediate foot of the *Panwri* pass over the snowy range from *Canaur* into *Sivarra*, and on N. side of the pass. This place is confined by cliffs, which rise perpendicularly above it, to the height of 3736 feet. Water boiled at 190° of Fahrenheit. I crossed the ridge on the 25th June, at 11 a. m. in a heavy shower of snow.
Touthie	31	15	19	*Bischer*	Village on the *Indravati* river, which falls into the *Paber*.
Roorou	31	11	35	*Ditto*	Large village on the *Paber* river, which joins the *Tonse* near *Raghai*.
Hurneoul	31	57	29	*Ditto*	Large village in the *Nora* district.
Wartoo, (fort)	31	14	44	*Comarsén*	*Wartu* or *Hurtu* mountain, 7m. 3f. S. E. of *Cotghur*. Height of the mountain above the sea, about 10,060 feet. During a residence of 7 days on this peak, in July, I could only get one observation for the latitude, and that a bad one, the mountain being enveloped in dense clouds.

Places.	Latitude. °	′	″	Province & District.	Remarks.
(On or near the river Jumna, within the mountains of Jaunsar, Sirmor, and Rewaen.)					
Bairat, (fort)	30	34	31 ·7	*Jaunsar*	Fort, on the high peak of the mountain, 3 m. west of the *Jumna.*
Murlang	30	36	53	*Ditto*	Village, in the glen on the *Silgad* river, which joins the *Jumna,* 5 miles east.
Lakha-man'd'al	30	43	24	*Sirmor*	Right bank of the *Jumna. Lakha-man'd'al* is said to have been a place famed in *Hindu* story, as one of the favorite haunts of the *Pan'd'us.* There were a great number of temples and idols here, but they appear, in a great measure, to have been buried by a slip of the side of a mountain, which overhangs their scite.
Paunti	30	48	8	*Rewaen*	Village, on right bank of *Jumna,* and 400 feet above it. *Rewaen* is the upper division of *Gerhwal,* and chiefly subject to the *Gerhwal Rájá.*
Gira	30	52	8	*Ditto*	Village, on the side of the mountain, in the *Banaul* glen, 5‴. 7′. from the right bank of the *Jumna.*
Thanno	30	49	12	*Ditto*	Small village, right bank of the *Jumna,* and 400 feet above it. Cross the river on a low *Sangha.*—Breadth of the river, 40 feet, but deep, and falling in cataracts.
Catnaur	30	51	35	*Ditto*	Small village, left bank of the *Jumna.*
Oj'hír ghur or *Wazír ghur*	30	54	47	*Ditto*	Right bank of the river, small hamlet, 500 feet above the stream, which is confined by mural precipices of great height. A small fort here. Most of the villages in this neighbourhood were buried by the fall of the cliffs above, in the earthquake of 1803.
Banassa	30	56	50	*Ditto*	Bad and uncertain observation. Weather thick. Small village, at the confluence of the *Banassa* river with the *Jumna.* There are 10 houses here; the rest were buried, last year, by a slip of the precipices. Appt. alt. of *Jumnautri* east snowy peak, as seen hence, 15°. 34′. 45″; of west peak 17°. 13′. 30″.
Curs'áli	30	57	37	*Ditto*	Left bank of *Jumna,* here 17 feet wide, and knee deep. *Curs'áli* is at the foot of the *Jumnautri* snowy peaks, and 3 miles from *Jumnautri.* In the latter end of April, the snow was 2 feet deep in shaded places in the village. There are about 25 houses.

Places.	Latitude. °	'	"	Province & District.	Remarks.
Jumnautri	30	59	10	*Rewaen*	The head of the *Jumna*, at the foot of steep snowy mountains of *Jumnautri*. The stream was 3 feet wide, and a few inches deep, formed by the melting of the mass of snow, which overlaid the bed, by the steam of the extensive and powerful hot springs, which are here. The bed of snow, concealing the stream, was 40 feet $0\frac{1}{2}$ inch in thickness. I descended to the bed of the stream, by a hole in the snow bed, made by the hot steam. Various domes and excavations in the snow, over-arch the *Jumna*;—they are caused by the hot steam. The bed of the stream, for the last $1\frac{3}{4}$ miles, is wholly concealed by deep snow; it is bounded by high mural precipices, at the distance of 50 to 100 yards asunder. Lat. by 8 sets of circum-meridional alts. of ⊙. A bad barometer stood at 20. 4.—Air 62°.—Mercury 37° (in snow) 21st April, 1817.
(*Jumnautri to Gangautri, &c.*)					
Shilba	30	49	12	*Ditto*	Deserted village, in the *Shilba* glen, which runs from the *Jumna* to the crest of the *Jackeni ghát*, on the range which separates the *Jumna* and *Ganges*.
Singha	30	44	53	*Ditto*	Village, right bank of the *Ganges*, or *Bhágírat'hí* river, and 1000 feet above it;—is 13^{m}. 5^{f}. above *Barahat*, and 5^{m}. 2^{f}. below *Reital*. Intermediate latitudes, lost by bad weather.
Reital	30	48	28 ·3	*Ditto*	Large village, $1\frac{1}{2}$ mile from the *Ganges'* right bank, and about 1200 feet above it. Above the sea, by barometer, 7108 feet. Beyond *Reital*, the course of the *Ganges* is through the most rugged region, perhaps, in the world. Water boiled at 200°. 5.
Dangul	30	54	32 ·8	Hn. *Ditto*	Halting place.
			28 ·8	Ht. *Ditto*	Left bank of the *Ganges*, at the *Sangha* or spar bridge. Breadth of the river, 50 feet—No inhabitants—Mural precipices bound the stream — Water boils at 202°—Distant from *Reital* 35, 126 paces. Lieut. HERBERT, Assistant Surveyor, joined me at *Reital*.

Places.	Latitude. °	'	"	Province & District.	Remarks.
Suc'hí	30	59	40 ·2 Hn. 40 Ht.	*Rewaen*	Small village, 1000 feet above the right bank of the river, where it breaks through those snowy mountains, which are seen from the *Doab* height of *Suc'hi*. Above the sea 8494 feet, by barometer. Water boiled at 199°.
Camp at cedar trees,	31	2	25 ·3 Hn. 8 Ht.	*Ditto*	Left bank of the river, within the snowy range, and at N. foot of *S'rí Cánta*, and *Sewmurchu Chaunta* snowy peaks. Bed of the *Ganges*, above the sea, nearly 8000 feet.
Derali	30	2	34	*Ditto*	Left bank. Village of 6 houses, deserted. Above *Suc'hi* and *Jhalu*, there are no inhabitants:—beyond *Derali* it is not habitable;—all rock and snow.
Bhairo-ghát'í	31	1	38 ·7 Ht.	*Ditto*	Right bank, at the confluence of the *B'hágírathí* (or *Ganges*) and the *Jahnaví* river, near the *Sangha*, and under precipices of vast height. A dangerous halting place.
Do	31	1	22 ·5	*Ditto*	Left bank. Cliff above the *Sangha*. Cedar trees.
Gangautri	30	59	29	*Ditto*	HODGSON's mean of α and β Libra—Ref. circle. HERBERT's Spica, α and β Libra—(two nights)—Sextant. HODGSON's eight circum-meridional alts. of Spica.
			35 ·5		
			27 ·1		
Mean	30	59	30 ·5		Side of the *Ganges*, here, 43 feet wide, and 18 inches deep,—strong current, 26th May, 1817. Height above the sea, 10,073 feet: this may perhaps be 2 or 300 feet more than the truth, as the mercury in the barometers was not well boiled in the tubes.
Near the *debouche* of the *Ganges* from the great snow bed	33	56	32 ·5	*Ditto*	HODGSON by α and β Ursa minoris—Ref. circle.
			37 ·5		HERBERT do. do. Sextant.
Mean	30	56	34 ·5		At a small spot of flat ground, right bank of the river. This place is amid snow, and surrounded by gigantic peaks, cased in snow, from top to bottom. The barometer indicated our halting place to be 12,352 feet above the level of the sea; one of the peaks was 9471 feet higher, and distant 42,480 feet, and bearing E. 46. 44 S. To the feet and flanks of this, and other great peaks, stretches a snow bed of unknown depth, and inclined at an angle of 7°.—It commences at 6500 feet from the present station, where the *Ganges*

Places.	Latitude.			Province & District.	Remarks.
	°	'	"		
					is seen issuing from under it. The breadth of the stream, was, on the 31st May, 27 feet, and 12 to 18 inches deep. The thickness of the snow bed, which overlaid the stream there, was estimated at between 250 and 300 feet perpendicular. The surface of the bed, was traversed as far onward as possible; its extent in length was about 6½ or 7 miles, its breadth 1½ miles; it entirely concealed the stream, which was not again observed; and there is every reason to suppose, its first appearance is at the *debouche*, which I will call MAHA'DE'O's hair, and the latitude of which is 30° 56' 06". There is no record of any person having penetrated to this place.

THE following observations of Eclipses of Jupiter's Satellites, will be useful in shewing the longitudes of *Seharanpur*, and several places in the mountains, the latitudes of which have been noted above. Till corresponding observations of these Satellites can be obtained from *Greenwich*, or some other Observatory, we must be content to compare them with the calculations in the Nautical Almanack.

Place.	Year	Month.	Mean time of observation.			Diff. in time.			Remarks.
			h.	m.	s.	h.	m.	s.	
Mr. GRINDALL's house, near *Seharanpur*	1817	July 13	11	32	35				
			6	21	57	5	10	38	This appeared to be a pretty good observation, but the air was not very clear.
Ditto.............	1817	July 29	9	50	58 ·6				
		N. A.	4	40	50	5	10	8 ·6	Emersion of Jupiter's 1st Satellite. Sharp and good observation.
Ditto.............	Do.	August 14	8	10	12				
		N. A.	2	59	51	5	10	21	Emersion, 1st Satellite. Good observation, but suspected. I saw it 3 seconds before, or at $8^h. 10^m. 09^s$.

Place.	Year	Month.	Mean time of observation. h.	m.	s.		Diff. in time. h.	m.	s.		Remarks.
Mr. GRINDALL'S House, near *Seharanpur*	1817	Aug. 21	10	5	13	·1					
		N. A.	4	54	56		5	10	17	·1	Emersion, 1st Satellite. Good sight.
Ditto	*Do.*	Sept. 6	8	24	17	·2					
			3	13	46		5	10	31	·2	Emersion, 1st Satellite. The observation seemed good, but the planet was rather low.
Ditto	*Do.*	Oct. 15	6	55	43	·3					
			1	45	25		5	10	18	·3	Emersion, 1st Satellite. A very good and sharp sight; a little moon light, but no hindrance.
Mean of the			6	0	0		5	10	22	·37	Telescope, DOLLOND'S 42 inch refr.—power 80—Chronometers, by BROCKBANKS and MOLINEUX; time, by equal alts. on all the wires of the circular instrument.
Dehra in the *Dún*	1814	April 25	8	0	40	·5					
			2	48	59		5	11	41	·5	Emersion, 1st Satellite—Telescope, DOLLOND'S 34 inch refr.—aperture 2ⁱⁿ. 7.—power 80—an excellent glass of its size. The *Greenwich* 42 inch refractor can only spare it one second of time, by actual trial.
Ditto	*Do.*	April 25	8	23	56	·4					
			3	11	12		5	12	44	·4	Emersion, 2d Satellite—It came out close to the 1st—but, as usual, gives almost 1ᵐ. later, or more, east longitude. Taken near the MEHANT'S temple.
Ditto	1817	March 9	17	37	43	·5					
			12	25	44		5	11	59	·5	Immersion, 1st Satellite—Good observation—DOLLOND'S 42 inch telescope—aperture 2ⁱⁿ. 7.—power 80. The above temple, distant 1ᵐ. 3ˢ. bearing 217°.
Ditto	*Do.*	Aug. 21	10	7	15						
			4	54	56		5	12	19		By Lieut. HERBERT—DOLLOND'S 42 inch telescope—same power, &c. as mine. At Captain YOUNG'S *Bungalow* - Latitude 30°. 19'. 17."5. Difference of longitude, compared with mine, some time, at *Seharanpur* 2ᵐ. 02ˢ of time. N. B. The *Bungalow* is a second of time west of my place of observation.
Ditto	*Do.*	Sept. 6	8	26	8	·2					
			3	13	46		5	12	22	·8	By Lieut. HERBERT, same place. This gives 1ᵐ. 51ˢ. east of mine of same night, at *Seharanpur*.

Place.	Year	Month.	Mean time of observation. h.	m.	s.	Diff. in time. h.	m.	s.	Remarks.
						5	12	59	An immersion of the 3d Satellite gave him 5. 12. 59. The date I have mislaid.
Chaur mountain, my pyramid, and station of observation..	1817	Oct. 15	6 1	55 45	34 ·9 25	5	10	9 ·9	Lieut. HERBERT.—Mine of same night, at *Seharanpur*, 6. 55. 43. 3. difference 8s. ·4. is rather too little—should be 15s.
Bhadraj mountain, N. W. end of the *Dún*	1814	May 2	9 4	54 53	35 ·5 36	5	10	59 ·5	Emersion, 1st Satellite. Good observation—N. W. peak of the mountain, at BALABHADRA's statue.
Ditto..............	Do.	Do. Do.	10 5	59 48	48 33 ·5	5	11	14 ·5	Emersion, 2d Satellite—Clear—The 34 inch telescope, which is one second of time later than the *Greenwich* refractor, with which it was compared in England.
Nahan	Do.	May 11	11 6	45 36	19 ·7 10	5	9	9 ·7	Emersion, 3d Satellite. A tolerably good observation, below the west end of the town.
Ditto..............	1816	April 1	10 5	39 30	29 ·2 19	5	9	10 ·2	Immersion, 2d Satellite. A good observation. Satellite lost light for 32 seconds, before it disappeared—At Captain WILSON's house, N. of the above place.
Ditto..............	Do.	May 9	10 4	56 47	50 22	5	9	28	Emersion of 1st Satellite being interrupted, I did not get a very good observation. Captain BIRCH's house, 100 yds. east of the other place.
Matiana, in *Comarsén*	Do.	May 25	8 3	15 4	23 49	5	10	34	Emersion, 1st Satellite. Not a good observation—The telescope, unsteady.
Tranda in *Canaur*, on the *Setlej*, within the *Himalaya*	Do.	June 17	8 3	29 17	58 21	5	12	37	Emersion, 1st Satellite—a fine observation, and valuable. A long set of distances of sun and moon, taken by the reflecting circle, give 5h. 12m. 24s.—Lat. of *Tranda* 31°. 33'. 42".—All the above by me, with 34 inch telescope.

Place.	Year	Month.	Mean time of observation. h.	m.	s.	Diff. in time. h.	m.	s.	Remarks.
(On the Jamna, within the mountains of Rewaen)									
Gina	1817	April 9	14	41	55·5				
			9	28	26	5	13	29·5	Immersion, 2d Satellite. Very clear observation—Satellite lost lustre 32^s. before it went. This and the following observations, by me, with the 42 inch telescope. On the 10th, I took the 1st Satellite; there was some doubt in noting the time, but I believe it will give 5^h. 12^m. 40^s.
Banassa	Do.	April 16	17	16	5				
			12	1	29	5	14	36	Immersion, 2d Satellite. A tolerable observation—but the dawn was beginning: I think it might otherwise have been seen 3 or 4^s. later,
Curs'áli, near *Jumnautri*, which bears 41° N. E.	Do.	April 17	16	3	42				
			10	50	33	5	13	9	Immersion, 1st Satellite—I suspected I saw the glimmer till 16^h. 03^m. 46^s. or 4^s. later, but not certain—Air very clear—Same day, Lieut. HERBERT observed the immersion at *Sikri* in *Rohilc'hand* at 16^h. 05^m. 28^s. Difference 1^m. 46^s.—*Sikri* is between *Bareilly* and *Chandausi*.
(On the Ganges, within the mountains of Rewaen)									
Reital	Do.	May 10	16	14	21·5				
			11	1	5	5	13	16·5	Immersion, 1st Satellite—Same telescope. Air clear, but there was a slight wind.
Ditto	Do.	May 12	10	42	6				
			5	29	33	5	13	23	A very fine observation, considering that the planet is so near opposition. The air calm, and in these elevated regions, exceedingly clear. Satellite lost lustre 50^s. before it went. Same night, Lieut. HERBERT's observation—The immersion at 10^h. 42^m. 09^s. 9. at *Chakoorwara*—lat. 30°. 22′. 30″.
Ditto	Do.	May 11	14	13	35·7		18		
			8	57	42	5	15	53·7	Immersion of the 2d Satellite—Clear and steady—I followed the Satellite deep into the shadow. It continued to lose lustre for no

Place.	Year	Month.	Mean time of observation. h.	m.	s.	Diff. in time. h	m.	s.	Remarks.
									less than 76 seconds, before it finally disappeared. It gives a longitude more than usually east of the 1st Satellite. The planet being now so near opposition, is large and bright, and its glare is some impediment to the precision of observation.
Suc'hi	1817	June 13	9	28	28 ·7				Emersion—1st Satellite.
Himálaya			4	13	36	5	14	52 ·7	Night clear, and no moon. Lieut. HERBERT and I, both observed; he caught the first glimpse 3 seconds before I did so; I have recorded his sight of it.
N. B.—For the latitudes of this and the foregoing places, see the list of latitudes.									

WE could not take any observations of the Satellites higher up the *Ganges* than *Suc'hi*, as the great height of the impending cliffs, (some times 50°. above us), prevented our seeing Jupiter, when the Eclipses took place. By the same cause, I have lost many observations in other parts of the mountains.

THE longitudes of all the snowy peaks, visible from it, will be deduced from the meridian of *Seharanpur*, by triangles, as well as their latitudes, distances and heights. The base for the purpose is that of the *Chaur* mountain and *Seharanpur*, the station signals at each place, being visible from the other, and at the distance of sixty-one *British* miles. The angles of the grand snowy peaks have been taken at each station with the circular instrument, as well as their apparent altitudes at different times.

Places.	Latitude. °	′	″	Province & District.	Remarks.
(March of the Reserve from Rewarrie, towards Jaipur.)					
Rewarrie, (Camp, Head quarters)	28	11	1	*Delhi*	7 furlongs S. W. of the town of *Rewarrie*. Longitude, west of S. E. angle of the city of *Delhi* wall, 2m. 28s. 5 of time or 37′. 07″. of space, by transferrence of time, by MOLINEUX's chronometer.
Camp, near *Bhawul*	28	3	59	*Kanaund*	Camp, 6 furlongs S. of the town. Distance 9m. 1f.
Camp, near *Bairud*	27	53	1	*Alwar*	Distance to *Shahjehánpur*, 11m. 3f; to *Bairud*, 10m.
Goojerbas	27	49	16 .1	*Ditto*	5 furlongs S. of the village: distance 8m. 1f.–Hence, the observations were taken conjointly with Captain BARTON, Assistant quarter master general.
Cat'h putli	27	41	53	*Ditto*	Belongs to a small chief—1m. 3f. S. west of the town of *Kote*; distance about 10 miles, but the wheel broke on the road—Longitude 24′. 15″. west of *Rewarrie* camp.
Prayágpur	27	35	41 .1	*Jaipur*	7 furlongs S. W. of the town. Distance 9m. 1f.
Babra	27	26	31 H. 22 B.	*Ditto*	2 miles S. W. of the town. Distance 11m. 4f.
Manoherpur	27	16	50	*Ditto*	1½ miles S. of the town. Distance 13m. 3f.
Samoat	27	11	46 H. 45 .2 B.	*Ditto*	6 furlongs east of the town gate. Distance 12m. 2f.—Longitude by chronometers, 26′ west of *Kote*, and *Putli* camp.
Nanghal	27	3	35 .2	*Ditto*	Distance 10m. 6f.
Juwára	26	56	35	*Ditto*	Head-quarters. Distance 9m. 6f. *Jaipur* is distant about 9 miles.
Sanganér	26	49	10 .9	*Ditto*	Mean of several sets of observations, by Captain BARTON and myself—Head-quarter, Camp. Distance 10m.0¼f. The N. W. bastion of the town of *Sanganér*, distant 1½ furlongs, bearing 164°. 90′. *Jaipur* is about 7 miles from *Sanganér*—Longitude, west of *Samoat* camp, by chronometers 1′.

Places.	Latitude. °	′	″	Province & District.	Remarks.
Circumstances rendering it out of our power to take any observations in the city of Jaipur, we measured a sufficient base, and took the distances of such remarkable objects there as were visible, and from the Trigonometrical observations, found the latitudes of the following places to be:					
High pillar, near the observatory in *Jaipur* ..	26	55	0		Total distant, *Rewarie* camp to *Sanganér*, British 125^{m}. 7^{fur}.
Palace of *Nehr-gerh*, on the hill	0	55	12		
Fort above east end of the town	0	53	53		
Fort of *Mootie Doongrie*, between *Sanganér* and *Jaipur*	0	53	10		
Fort of *Atronie*, without the wall, at S. W. angle	0	54	26		The pillar east of *Sanganér*, camp 2′. 30″. Center of the city, nearly 3′. 14″. or 1°. 12′. 38″. west of the east wall of *Delhi*, which I take to be about 77°. 14′. 15″. east of *Greenwich*, and *Jaipur* 75°. 10′. 07″.—Longitude, east of *Greenwich*.
(*Sanganér, to Rewarie town, by Raj-gerh and Alwar.*)					
Gunar	26	4[illegible]	37 .5	*Jaipur*	East side of the town. Distance from *Sanganér*, 9^{m}. 2.
Bijai Bassei	26	49	55	*Ditto*	East side of the town. Distance 10^{m}. 2^{f}.
Jeitwarra	26	52	36	*Ditto*	East side of the village. Distance 10^{m}. 3^{f}.
Kala Pahár	26	58	59	*Ditto*	1 furlong east of the small fort on the hill. Distance 14^{m}. 1^{f}.
Carnaul	27	7	14	*Ditto*	2 furlongs N. E. of the village, part of it belongs to *Jaipur*, and part to the Rum *Rájá*. Distance 14^{m}. 7^{f}.—Observation of the latitude, not good. They call the country here *Dhoondar*, and the *Pergunna*, *Bhatteri*.

Places.	*Latitude.* °	′	″	*Province & District.*	*Remarks.*
Raj-gerh	27	13	48	*Alwar*	A large and strongly fortified town in a recess of the hills, belongs to the RAM *Rájá* of *Alwar*; 3 furlongs west of the town. Distance 10^m. 4^f.
(*Longitude of Raj-gerh, east of Sanganér, 49′. 30″. by Chronometer.*)					
Malaccera	27	24	33	*Ditto*	A strong mud fort in the plain, with *rauni* and ditch, and a stone citadel within 4 furlongs N. of it. Distance 11^m. 3^f.
Alwar	27	34	1	*Ditto*	A large and strong town at the east foot of a steep hill, which is fortified—2½ furlong from N. E. angle of the town. Distance 13^m. 4^f.
Bahádurpur	27	39	47	*Ditto*	Small town and fort on a low hill. Distance 11^m. 1^f.
Crishna-gerh	29	49	31	*Mewat*	West side of the fort, which has about 16 stout mud bastions, a *rauni* and ditch, and a stone citadel within,—stands on the plain, and belongs to RAM *Rájá*. Distance 12^m.
Cot Cásim	28	1	34	*Ditto*	Small open town, belongs to the palace at *Delhi*. Distance 15^m. 3^f.
Rewarri	28	11	30	*Delhi*	Commissariat office—*Rání-bágh*, west side of the town. Distance 15^m. 3^f.

THE latitudes in this list were deduced from meridian and circum-meridian altitudes of the sun and stars, taken with sextants, or, more generally, by TROUGHTON's reflecting circles—Except four places in *Huriána*, and five in the city of *Jaipur*, the latitudes of which were obtained by trigonometrical processes.

ERRATA.

Page 170—line 36, for 7108 read 7411 feet.
171 —line 5, for 8494 read 8869
do—line 3, for 10,073 read 10,319

IV.

Description of a Zoophyte, commonly found about the Coasts of Singapore *Island,—with a Plate.*

BY MAJOR GENERAL THOMAS HARDWICKE, F. R. L. & A. S.

Read 13th November, 1819.

THIS subject belongs to the Genus Spongia, to the class Vermes—and is of the order Zoophytes.—From its peculiar form, we propose to term it

SPONGIA PATERA.

ROOT.—Branching, the shoots of various thickness, from the size of a finger to 3 inches in diameter, slightly diverging, composed of earth, sand, and broken shells, and very fragile.

STEM.—Cylindrical, of the same cellular texture as the bowl, and about the same length, in circumference, pretty equal—from 15 to 17 inches diameter—surface porous.

CUP—or BOWL.—Circular—and subconical, in diameter at the brim 17 inches, about the middle $12\frac{1}{2}$, and near the bottom 7 inches, capable of containing thirty six quarts of water: in substance corky—but non-elastic, made up of cells or tubes—running into one another, and divided by a slender membrane, not more than half a line in thickness: over the whole surface, both within and without, are spread innumerable pores, the mouths of which are closed with capillary—cottony—fibres in converging radii from the circumference to the centre of each pore; these when seen under the power of a common lens, have a dense downy appearance.

THE height of the specimen, from which this description is taken, is 37 inches, and something larger than one presented to the Asiatic Society by JOHN PALMER, Esq.

IN an Essay on *British* Sponges, by the late GEORGE MONTAGU, Esq. printed in the 2d volume of the *Wernerian* Society's Transactions, is described—" Spongia Scypha "—which bears some resemblance to the specimen from which the plate annexed was taken, but it is diminutive in all its parts, when compared to this Indian species.

V.

Description of a substance called Gez *or* Manna, *and the Insect producing it.*

By Major General THOMAS HARDWICK, F. R. L. & A. S.
Vice President.

Read 17th June, 1820.

I BEG to lay before the Asiatic Society some information upon a subject which forms a paper in the first volume of the transactions of the *Bombay* Literary Society. Captain Edward Frederick, of the *Bombay* Establishment, has given his remarks on a substance called *Gez* or *Manna*, found in *Persia* and *Armenia*,—but the doubt of authors who have written upon the same subject, seems by no means cleared up, as to whether this substance be the produce of an animal, or whether it be a vegetable gum; and Captain Frederick concludes his paper with remarking that "at some future period it may be proved to be the pro- "duction of the Aphis tribe, instead of vegetable gum."—The celebrated *French* Entomologist Geoffroy, has already attributed to a species of Chermes, the property of producing both in the Larva and Pupa state, a sugary substance of a white colour, resembling Manna; and it is in con-

firmation of this opinion, that I have the honor of laying before the Society, drawings of both the insect which produces this Saccharine matter, and also of the substance itself, together with indisputable evidence of one of the many trees on which this Manna may be found.

FOR the facts which I have the honor to lay before the Society, I am indebted to my liberal and zealous friend Dr. WALLICH, and to Dr. C. HUNTER, through whose kindness the above specimens have been obtained.

THE insect about to be described, appears, from the imperfect stage under which it is examined, to belong to the Genus Chermes, and we propose to name it *Chermis-Mannifer*: we have yet seen it only in the larva state.

Chermis-Mannifer, in size, is about the bulk of a domestic bug (cimex lectularius), of a flattened ovate form, tail rounded. Snout longer than the thorax, inflected and pressed down between the legs—Antennæ, as long as the thorax, of three joints, the 1st minute—2d Clavate, and much the largest—the 3d Setaceous, legs long—formed for walking—the tarsi, three jointed, hind legs longest—the rudiments of wings not yet evident.—The general colour of the insect is a light brown—the rings of the abdomen are marked with a dark spot or stroke on each side of the dorsal line, which is of a paler brown.

FIG. 1—shows the natural size of the insect, and figs 2 and 3 are under and upper positions of the same, magnified; fig. 4, shows the larvæ

in their natural state, covered with a white filamentous or cotton like substance.—Fig 5, is the same parcel of the larvæ, removed from the leaf and reversed, which exhibits an undefinable mass, by the confused mixture of legs, somewhat darker, by having dried on the leaf.—Fig. 6, shows a fragment of the Manna, in the state it was taken from the tree.—It is found however in pieces of various shapes; some flat, as taken off the leaves of the tree; sometimes in cylindrical pieces, impressed with the figure of the stalk or branch on which it has fallen.

THE formation of this substance upon those parts of the tree from which the insect does not receive nourishment, may appear difficult to account for, but if the economy of these infestors of plants, the cocci and the aphides be attended to, the difficulty will vanish.

THE Revd. Dr. KIRBY, in his introduction to Entomology, vol. 2d page 89, has given a most interesting description of the natural economy of these tribes of insects, or rather of the aphides; and I have witnessed all he relates on "the loves of the ants and the aphides."—It is not therefore in my mind a matter of difficulty, or unreasonable to suppose, that had the numerous aphides, I have seen drawing their nourishment from the succulent parts of a plant, been unattended by the multitude of large black ants, incessantly urging them to part with the luscious drop, I should have seen the accumulation of this limpid liquid from a thousand springs trickling down the leaves and stem, drying as their surfaces spread, and drop after drop forming incrustations, bearing impressions of the branch or leaf, and like the substance I now produce before the Society.

To what I have stated above, I shall add the observations of Mr. HUNTER, which are of material importance to the subject of this paper, as relating what he himself saw:

Extract of a letter, dated Camp, Pachmári, *11th March,* 1819.

" I SHALL now try to describe to you a natural curiosity which I found " in my rambles in these hills; and I have inclosed a few of the insects " with a specimen of the substance, which, it appears, they have the " power of generating from their bodies. The substance appears to pro- " ject from the abdomen in the form of a tail or bunch of feathers, of a " nature more like snow, than any thing I can compare it to. These in- " sects are found on the branches and leaves of trees, on which they " swarm in millions, and work and generate this feather like substance, " till it gets long, and drops on the leaves, caking on them, and resem- " bling the most beautiful white bees wax; this hardens on the leaf, and " takes the complete form of it, which you can strip off, bearing the very " impression and imitation of the leaf itself, which no art could exceed. " But, what appears surprising, they do not seem to eat or destroy the " leaves they swarm on, and though they may have been some days on " the leaves, nothing more is seen than this waxy substance issuing " from the tail. I have seen a great deal of it about these hills, and much " might be collected, I should suppose, were it desirable; there are no " inhabitants however about here. We have been on the top of the range, " since the month of December, watching the movements of the Ex- " *Rájá* of *Nágpur*. Our position is about south-west of *Hussainábád.*

"The climate is good.—The thermometer 58° at sun-rise, 86° at noon, "and 80° at sun-set. No hot winds as yet."

THE small branch with flowers received from Mr. HUNTER, proves to be a climbing species of celastrus.

A MORE perfect account of this insect must depend on the opportunity of observing it in all its stages—the whole of what we had for inspection (about 100) were apterous, and the abdomen of all totally destitute of those processes which distinguish most species of Chermes from the preceding Genus Aphis.

THE appearance of the insect, before being handled or disturbed from the leaves and branches they form on, furnishes a character admitting of comparison with another species of Chermes—viz. Chermis Alni*—which in the larva state is covered with a viscid, downy, filamentous substance—so are the insects under inspection in their native haunts; but however light and flocculent this may have been when first taken, the pressure it has undergone in a transit of several hundreds of miles, must be considered as likely to rob it of that character.

* Chermés found on the Betula Alnus.

VI.

An account of Trigonometrical and Astronomical Operations for determining the Heights and Positions of the principal Peaks of the Himálaya *Mountains, situated between the latitudes of* 31°. 53′. 10″. *and* 30°. 18′. 30″. *N. and the longitudes of* 77°. 34′. 04″. *and* 79°. 57′. 22″. *E.*

By Captain J. A. HODGSON, 10th Regt. N. I. *and*
Lieut. J. D. HERBERT, 8th Regt. N. I.

ON the successful termination of the first campaign against the armies of *Nepul* in 1815, in which they were expelled from their conquests in the mountains between the rivers *Setlej* and *Kali* (or *Gograh*) by the *British* forces under the respective commands of Major Generals Ochterlony and Martindell, and Colonel Nicolls; and the provinces of *Gerhwal, Sirmor, Hindur, Bisaher* and *Kamaon*, with the exception of some small districts, being restored by the *British* government to the *Hindú Rájás*, their ancient possessors, the Most Noble the Governor General in Council was pleased to direct, that surveys of the above countries should be executed by Captain Webb and myself. To Captain Webb, who was then in *Kamaon*, the survey of that province and of the eastern parts of *Gerh-*

wal was assigned; and to me, that of the western part of *Gerhwal*, and of the mountains between the *Ganges* and *Setlej* rivers. My instructions were summarily, "to make a correct survey of the liberated provinces "of *Gerhwal*, *Sirmor* and *Hindur*, as well as of the countries to the "north of them reaching to the *Himálaya*, a tract which comprises the "sources of the *Ganges*, *Jumna*, *Tonse*, (hitherto unknown, though larger "than the *Jumna*) and *Setlej* rivers; and which is bounded by some of "the noblest mountains in the world." I was ordered to carry on my researches as far as rationally practicable, and Colonel CRAWFORD, then Surveyor General, was directed to prepare such instructions for me as he might deem necessary. That distinguished and scientific officer, alike versed in the theory and practise of great surveys of this nature, approved of the methods I had suggested, for carrying on my operations, and generally directed me to be guided by such circumstances, as might appear to me most conducive to the objects in contemplation.

IT will be acknowledged, that the extension of geographical knowledge is a desirable object, and it cannot be denied, that to ascertain the heights and positions of the snowy peaks of the *Himálaya* is not only an interesting and curious, but very useful, inquiry, for when their latitudes and longitudes are known, the geographical position of any place, from whence one, or more of them, are *visible*, may be determined with ease and accuracy. We have every facility and opportunity of observing some of these resplendent and lofty guides, in the great extent of 15½ degrees of longitude, now, either in our possession, or under our influence and control, from the banks of the river *Setlej* at *Ludiana*, to beyond those of the *Burrampooter* in *Bengal*.

IN all this belt, the outline of some of the snowy peaks may frequently be observed, in clear weather, to the distance of 150 miles and upwards, with sufficient distinctness, for an observer to fix his *own position*, by obvious methods; and thus, to be enabled to correct the geography of the older maps. But as yet, we do not, by Captain WEBB's survey, and that of Lieutenant HERBERT and myself, know the precise latitudes and longitudes of any peaks further to the S. E. than the latitude of 29°. 19'. 43". and longitude 81°. 2'. nearly. It would be very satisfactory, to determine the positions of those more eastern peaks, visible from *Patna*, *Monghir*, *Bhagalpúr* and *Rájmal*, and this may be done with considerable precision, by their *Azimuths*, taken at the above places, with their observed differences of latitude, and differences of longitude, taken with good chronometers, carried down the river in fast going light boats, when the stream is most rapid: the boats would reach *Monghir* from *Patna* in a day, and two good chronometers, ought to give the difference of latitude, within a quarter of a mile. The chronometrical measures, may also be compared and corrected by differences of longitude taken by the firing of gunpowder: the flash of half a pound of gunpowder, fired at the hill house at *Pír Pahár* near *Monghir* would be seen at *Janghíra* rock, from which, a flash would be seen at *Patter Ghatta*, below *Bhagalpúr*, and thence at *Pír Pointí* or *Sicri Gallí*, or probably *Rajmal*. I am by no means sure, that a flash from the top of the *Golah* at *Patna*, might not be seen at *Pír Pahár*, as Baron VANZACH observed the effects of this sort of illumination at places, so far distant from each other, as to be reciprocally concealed from sight, by the curvature of the earth. By this method much may be done, and the longer the line the better. Of course it requires a

good observer at *each* place, with one or two assistants, good instruments, and great alacrity, and the mean of *alternately* repeated flashes; and to such extent as they may be visible, this method is above all astronomical operations, for determing differences of longitude, the most certain. But to return to the subject immediately under consideration. Having received my instructions, I proceeded from the army, on the immediate frontier of *Nepal* to the upper part of the *Doab* in the *Sehâranpúr* district, in which, or in the *Dêhra Dún*, or valley, I intended to begin my operations, by measuring a base of four or five miles in length, if the ground should prove favorable. On examining the plain lying at the southern foot of the hills, between the *Ganges* and *Jumna*, I found there were several places where I might measure a line of *three or four miles*, but that on account of the mango groves, with which the country is studded, it would be very difficult, if not impossible, to extend the sides of the *triangles*, which would increase in length considerably, before I could prolong them to the feet of those low hills, which divide the plains from the *Dún*. On the summits of the last mentioned hills, I intended to establish stations proper for obtaining others, on those loftier mountains, which bound the *Dún* to the north, and command views of the *Himálaya* peaks, as well as of the plains. When the distances between some of these points, and *Sehâranpúr*, as well as their reciprocal distances from each other, should be established, I intended to use those lines as *bases*, whereon to determine the positions of the snowy peaks, as has since been done. The search of the ground having proved unsuccessful in the plains, I proceeded, for the purpose of making a similar examination, to the *Dún*, to search for more favorable ground. The *Dún*, though a valley, has an uneven surface, sloping

from the hills, which bound it to the north and south, to the two rivers *Soang* and *Asun*, which have their courses from its centre in different directions, to the *Ganges* and *Jumna:* much of the sloping ground of the valley is covered by forests: the central part, near the rivers, is more open, but marshy, and overgrown at the season, when I examined it, by high grass and reeds, which cannot be destroyed by burning, before the commencement of the warm weather, untill which time it is detrimental to health to remain in such places, and the tigers and wild elephants which then abound in the thick cover are troublesome: at a later season I might have been more successful in finding clearer ground, but I began to re-consider whether a plan which I had long before had under consideration, might not nearly or wholly obviate the necessity of measuring a base, an operation well known to be very tedious, and with limited means exceedingly difficult: to execute it in the precise manner, which is requisite when the object is to measure an arc of the meridian, a number of coffers, tripods and elevating screws would be necessary, and even if I could have procured workmen to make them, they must have been cut out of unseasoned timber, which would warp and cause much uncertainty. How some of these difficulties were afterwards obviated by Lieutenant HERBERT, will appear in the account of his measurement of a base.

THE method by which I hoped I should be able to avoid the trouble and loss of time incident to the actual measurement of a base, was this: to determine as accurately as I could the *difference of latitude* of two places in *sight of each* other, but as far distant as possible: this difference of latitude with the observed *Azimuths,* I considered, would shew the number of

feet due to it, and consequently, the observations being supposed correct, the distances of the two places, which might be used as a base of great magnitude. The stations I selected for this purpose were first the house of Mr. GRINDALL, the judge and magistrate of *Sehárampúr*, which for the sake of distinction we shall call *Belville*, a very large and conspicuous white building in an open situation, one mile and a half south of the town of *Sehárampúr*. The second or northern station is a very remarkable and lofty mountain, which divides the hill provinces of *Sirmor* and *Júbal*, called the *Chúr* or *Chúrked'hár*: its summit is upwards of 11,000 feet above the level of *Sehárampúr*; the point where I fixed the station is 10,650 higher than the station at *Belville*, from whence its *Azimuth* 3°. 25'. 05". to the west of north, a direction *so near the meridian*, being extremely valuable, in determining the distance in the manner I proposed. The station mark on the *Chúr*, is a pyramid which I built of pine trees, rock and turf, 35 feet high: it is visible from *Belville* with the instruments I intended using, and the south point of the line there, is seen from the *Chúr*, by firing white lights on it at night.

THE distance of these stations is upwards of 61 B. miles, a distance sufficiently long to serve as a base for the most distant snowy peaks visible from either end of it, and I hoped, that by taking a great number of zenith distances at each place, I should be able with a reflecting circle, to determine the difference of latitude within two or three seconds, which, relatively to the *great length* of the arc, (upwards of 53 minutes) could only occasion a small uncertainty in the distance, and of course, a much smaller in the elevation of the objects to be observed from its extremities. Experience

shewed that this degree of accuracy could not be attained by myself, or Lieutenant HERBERT, though I had much larger and more perfect instruments than have hitherto been used in the mountains, or in any survey on this side of *India*; and both of us had much practise as observers. When I had less experience, I was more confident as to the accuracy which I thought might be obtained from celestial observations, frequently and carefully repeated; but now so far from being satisfied with surprisingly close results, *more close*, than the *Data* and instruments warrant, I incline to consider them, the effects of chance. I hold it to be the part of a faithful observer, to reject no observations, except where he is *sure* from some *known* cause, that they are bad. It has been said, and I think with justice, that when experienced observers, after taking all the pains and precautions in their power, find themselves embarrassed by discrepancies for which they cannot account, they are probably on the point of making some important discovery: at any rate though they may not be so fortunate, they may by making a fair disclosure, enable others who may view the subject in a more happy point of view, to do so. Even in the great *English* trigonometrical survey we see that the latitudes of principal stations taken by different stars when under favorable circumstances, and with powerful zenith sectors of five and eight feet radius, have some times extreme differences of 8" or of 4" from the mean. Ours being taken with instruments of only six inches radius, and with telescopes of small power, may be expected to be much more discordant; of course they are so, but really not in proportion to the power of the instruments. Reference to the table of 61 latitudes taken by me at *Belville*, and the same number by Lieutenant HERBERT, of stars on different sides

of the zenith, will shew that the differences are less, than could be expected, and how closely our mean results agree, indeed I think too close, but they are fairly stated. Though at *Belville* we could observe at our ease, it was not so on our lofty stations of the *Chúr*, *Surkunda*, and *Bairát* amidst snow, ice and clouds, and exposed to furious tempests, which the astronomer in his firm observatory never experiences. But even the mean of Lieutenant HERBERT's observations and mine, varied at the *Chúr*, only 4″, which is less than could be expected.—Two observers may chance to find the *same* result, and yet it may *not* be true. Whether it be so, or not, may be proved. To prove, whether, the difference of latitude of our large arc, *Belville* and the *Chúr*, was certainly determined, I established a third or proof station on the fort of *Bairát*, the three places making a well proportioned triangle. *Bairát* is a small fort on the summit of a mountain in *Jaunsar*. The station of observation is in the fort, and distant from *Belville* 2,59,129 feet, and 6,556 feet nearly above its level. There, as on the *Chúr* and at *Belville*, a great number of observations for the latitude were made, by Lieutenant HERBERT and myself at different times, but with the *same* reflecting circle: but the mean of our observations differed 7″.* At all the three stations, the angles and *Azimuths* were carefully observed, as will be shewn in the detail, yet we had the mortification to find that the latitude of *Bairát*, as deduced by strict *calculation* on the latitude and *Azimuth* arc, or base of the *Chúr* and

* 7″ is too great a discrepancy to be fairly attributable to error of observation only, perhaps it may have been caused in part, by the varying state of celestial refraction. I observed at *Bairát* in tempestuous weather, and was much interrupted by storms of wind, snow and sleet, and the atmosphere to the north zenith was generally cloudy. Lieutenant HERBERT was rather more favored by the weather, and his observations there are preferable to mine.

Belville did *not* agree, with the mean latitude actually observed at *Bairát*, at it ought to have done, but differed from it, ten seconds; had it differed only three or four seconds, we should have been content to sacrifice perfect agreement to gain time, and indeed it must be confessed, that having regard to the object in question, an uncertainty of three or four hundred feet in sixty-one miles and a half miles was not much; it would affect the *distances* of the remotest snowy peaks only to the amount of about 600 feet, in the whole; and the nearer peaks, less in proportion: the heights would be very little altered, nor would the uncertainty even of 10" or 330 yards materially affect them, but the latitudes and longitudes, would be uncertain and unsatisfactory. Much chagrined at the disagreement, we were at a loss what steps to take; whether to consider the latitude of *Belville*, as satisfactorily settled, and that of the other two stations as erroneous, or to divide the error equally between the three. Still suspecting that some oversight had taken place, though none seemed palpable, we determined to try a second proof station, in hope it might throw some light on the subject: for this purpose the mountain of *Surkanda* was fixed on, which is distant from *Belville*, 2,86,212 feet and 8,300 feet higher than it. There, latitudes, angles and *Azimuths* were observed, and again the observed, and computed latitudes differed, to the amount of some seconds, and in the same manner as at *Bairát*, the computed arc proving greater, than the observed. On the *Wartú* mountain, also which is distant nearly north from the *Chúr*, 111,634 feet, and 1016 feet lower than it, a station was established, when operations, similar to those noted above, were effected: the best latitudes there were observed by Lieutenant HERBERT, and though not so numerous as those at the *Chúr*, *Belville*, *Bairát* and *Surkundu* stations,

agreed very well with each other. These gave the differences of the observed and computed arcs, in a contrary sense to those at *Bairát* and *Surkunda.*

THUS perplexed, we despaired of arriving at the accuracy we aimed at, by the methods of differences of observed latitudes and *Azimuths*, and resolved, cost what time it might, to try to clear up the difficulties, by measuring a base. An operation which I always foresaw might be necessary, but which I wished to avoid if possible—mean time the trigonometrical affairs of the survey went on, combined with geographical researches, and at many commanding points, stations were established, angles taken, and pyramids as station marks built, which were alike necessary, whether it should be determined to abide by the results of the latitude base, or to resort to a measured line. This operation, if undertaken, could not be immediately effected, but would necessarily be deferred, till a convenient season, for this survey embraced many objects of geographical research, as well as trigonometrical and astronomical operations, which could not be carried on at the same time. An inspection of the map will shew the great extent of the country explored, and its rugged and mountainous nature, in traversing which, many difficulties present themselves, and it is only at certain seasons, that the snowy regions and upper parts of the courses of the great rivers can be visited. Even the principal stations are on high mountains. The *Chúr* is higher than mount *Etna,* and the snow lays deep on its north side, generally till the commencement of the rains in June; the mountain is then shrouded in mist and clouds. The climate is too severe, to allow an observer to carry on his operations with success,

before the 20th April, and from that time, to the end of May, is the best season for the work. Also, after the autumnal equinox, the air becomes clear, and the atmosphere is favorable for vision, until the middle of October, when storms of snow, render the station untenable. Therefore, to these two periods, must visits to the *Chúr* be limited. The inconveniences of residing on such a stormy ridge, even at those seasons, are considerable. The fury of the wind is great, and the cold intense; immediately after sunset water and ink are frozen—and our followers, who were necessarily much exposed, suffered severely from the cold: the ascent of the mountain, was long, and arduous, and the grain required for the followers, for a period of ten or twelve days, was procured with great difficulty from the distant villages in *Sirmor* and *Júbal*, and it is to be understood, that in these mountains, between the *B'hágírat'hí* and *Setlej* rivers, camp equipage, instruments, provisions, and every thing required, was carried on *men's backs*, except on one short military line of route, where mules lightly loaded may occasionally be used. Sheep it is true, are also used, as beasts of burthen, in the higher mountains, but they carry very small loads—similar inconveniences and limitations as to the season of residing on them, occur at the trigonometrical stations of *Chandpúr, Bairát* and *Surkunda*, in a less degree, and in a still greater at *Kédar Kanda* and *Úchalárú*, which are higher than the *Chúr*, in or crossing the passes over the ever snowclad *Himálaya*, and in exploring the sources of the great rivers which rise in their deep and gloomy chasms. These and many other impediments delayed the arrangement of this memoir, to a later period than I could have wished, and I must be allowed to state some circumstances which rendered the delay unavoidable on my part, and that

of Lieutenant HERBERT: the first was want of assistance: two young officers of engineers, were indeed appointed my assistants, and joined me in 1816, but their services were soon afterwards required with their own corps. In May 1817, when on my way, to the source of the *B'hágírat'hí*, I was joined by Lieutenant HERBERT, of the 8th Regt. N. I. who had been appointed my assistant, and to his valuable aid I owe much. He accompanied me in the journey from *Reital* to the source of the *B'hágírat'hí*. After the rainy season of that year, during the *Mahratta* war, Lieutenant HERBERT joined his corps with the centre division of the army, and I marched with the reserve to *Jeypúr*. In April 1818, we returned to the mountains. In October 1818, I was obliged to leave them, and to go to *Calcutta*, in consequence of a dangerous disorder, contracted by exposure to frequent changes of climate, in the expedition to the head of the *Ganges*. On my recovery, I went to *Indore* in *Malwa*, being employed on military duty, and after an absence of nearly two years, having obtained leave of absence, I again visited *Seháranpúr*, for the purpose of meeting Lieutenant HERBERT, that we might jointly prepare this paper, in which we shall endeavour to shew, with as much accuracy as we can, the heights and position of a number of the *Himáļaya* mountains. It is incumbent on me to declare, and I do it with much satisfaction, that if any share of praise, should be awarded to our labours, by far the greater part of it, is due to the skill and unremitting exertions of Lieutenant HERBERT, who carried on the survey alone, after I was obliged to leave the mountains in October 1818. The instruments I used being my private property, I left the most valuable of them with him. We had agreed that a base should be measured, and in conse-

quence of my unavoidable absence, this laborious and difficult task was executed by Lieutenant HERBERT alone, and much of the apparatus was contrived by him, and executed under his inspection, in the manner he has described. The whole of the small triangulation for the purpose of correcting the stations of *Chandpúr* and *Surkunda,* in which he used my circular instrument, was his work, and he shared *equally* with me in the trigonometrical and astronomical observations of the large triangles, at such stations as I visited, and also established, as we had agreed, on other stations judiciously situated, and carried on operations on them—and our geographical knowledge of the surveyed country has been much extended by him, not only in carrying various route lines of the *Jáhnaví* river above *Bhairoghátí,* and of the *Setlej* above *Wongtú* (which was the furthest point of my research in that direction in 1816), but also in tracing the *Tonse* river to its sources in the snowy range; ascending which, in October 1819, he crossed over the southern ridge of the *Himálaya* by the *Gúnas* pass, elevated about 15,700 feet above the sea. Descending thence, he came upon the valley of the river *Baspa,* a principal feeder of the *Setlej,* originating in that cluster of high peaks, which are situated in a re-entering angle of the range above *Jumnotri,* and from which in another direction are derived the more eastern rivers. From its confluence with the *Setlej,* he followed the course of the latter upward to *Shipkee,* a frontier valley of the *Chinese* territories. *Shipkee* is in latitude 31°. 48'.; 110 miles below *Shipkee,* the *Setlej,* which by the *Bhoteas* or *Tartars* there, is called *Sang Jing Kanpa,* (*Kanpa* signifying a river) receives another stream, nearly equal in size, which strange to say, has no precise name. It is sometimes designated *Spatí,* *Maksang Spatí,* being the name of the *Purgunnah* it flows through, and

Maksáng signifying like *Kanpa,* a river. From the confluence of this river with the *Setlej,* he proceeded up to *Lári,* a frontier village of *Ladac.* In this part of his route he describes the mountains as entirely clay slate, bare of verdure and with little snow, and evidently of inferior elevation, from all which may be inferred that he was at this time on the northern face of the great range. Having no particular motives for penetrating further and the season being advanced, he returned from this place though he had little doubt, as he says, that if desirous he might have proceeded even to *Leh* the capital of *Ladac.* The road being described as good, and the people not manifesting the same jealousy as those subject to the *Chinese* authority. But this is not the place to enter into geographical particulars: an inspection of the map, and comparison with those which are published in *England,* will shew what has been done by Lieutenant HERBERT and myself in rectifying their *errors.* The memoirs I have to offer may be conveniently divided into the following subjects.—1st. A description of the principal instruments used in the Trigonometrical and Astronomical Operations, and in the measurement of the base: these were;

I. A PORTABLE *Azimuth,* altitude and transit circle, made by TROUGHTON: this with some other valuable instruments from his private observatory, were presented to me by my relative Mr. W. HODGSON, F. R. S. before I was appointed to the mountain survey. The construction and uses of this circle are described by the Reverend Mr. WOOLLASTON, in his *Fasciculus Astronomicus.* The diameter of the horizontal and vertical circles of my instrument, are each, one foot: the former is divided to five seconds, and is read by two opposite verniers,

the latter by means of micrometers, and is calculated to give elevations and depressions to two seconds. On the horizontal circle the divisions are cut in brass, and are very fine, but so close, that we were often puzzled to fix on the exact line of coincidence, for occasionally three lines on the vernier and limb appeared to the eye as equally coinciding: but in such cases we take the mean, and when there is time, the observations are sometimes repeated on different parts of the limb—an instrument of twelve inches is certainly not large, but a much larger could not be carried in the mountains. The weight is fifty pounds: with the two cases it weighs 116 pounds, and is carried in the hills on men's backs. The telescope was of twenty inches focal length, and had three eye pieces of the powers to thirty or forty nearly, and the wires, ten in number, being five vertical and five horizontal, were of fine spider's web. The advantages which circular instruments possess over quadrants or other portions of a circle are too well known to require much description. They can be more accurately divided than the latter, and are capable of complete reversion in every direction. The index and collimation errors, are determined on the observed objects *themselves*, and when terrestrial angles, or the pole star are taken, it may be done before expansion can have any effect on the instrument. Whenever practicable, the circle was used on a firm pillar of brick or stone work erected for it. As to the adjustments, and levelling, they were always performed, as usual in such instruments, by the ether level, but to make the altitude circle describe a true vertical, I used the method of bisecting the pole star, when at its greatest elongation, first observing it by direct vision, and immediately afterwards its image, with the faces of the circle, in both directions, and with the telescope

reversed in the ys.; it *then*, describes a true vertical. This verification cannot be effected, except on calm nights. The circle was used by Lieutenant HERBERT in taking *all the* angles of the small triangulation, and considering that it was *then* necessarily placed on a wooden tripod only, it performed well—at the great stations, *Belville*, the *Chúr*, *Bairát* and *Surkunda*, it had a firmer support. All the observations, as well horizontal terrestrial angles, as of altitudes and *Azimuths*, were determined by us, both by the single and double elongations of the pole star, and at the principal station of *Belville*, with great care; and I trust with as much truth as it is possible to take them, with an instrument of moderate dimensions. The altitudes of the peaks were observed at several places, and at different seasons, and the *mean* taken, except where a depression had been observed. As the stations are far distant from each other, it is evident, that the elevations and depressions could not be taken at, or very near, the same time, with the same instrument, but when they were observed, the circumstances of weather, were not very dissimilar, and it is hoped that the ratio of terrestrial refraction deduced, is sufficiently near the truth for answering the practical ends of the survey. As an instrument for taking zenith distances, the circle answers very well, when sheltered from the weather, but on the exposed peaks of the grand stations, we could not avail ourselves, as we wished, of its powers. I lost much time at the *Chúr*, in trying to do so, but the winds by night, were so boisterous, that it was impossible to keep the adjustments perfect, and to use it in a tent, which is in continual danger of being blown away, distracts the attention; at the station of *Belville* in the plains, where I was more at my ease, I made tolerably good observations for latitude, with the altitude circle, though not so

good as I ought to have done: some of the best, I think, are those made on the pole star when in the meridian, by observing at the same time its elevation, by direct vision, and by reflexion in quicksilver, by depressing the telescope, then reversing the instrument quickly, the same is repeated, and eight readings are obtained by the opposite micrometers: after this method occurred to me, I had only an opportunity of trying it on one night, after which cloudy weather came on, and prevented the reflected image being satisfactorily seen. Where the pole star is higher than it is here, I think very good latitudes may be thus taken: but at *Belville* the latitudes were generally taken by Lieutenant HERBERT and myself, with the *reflecting circle*, as it was proper that the same instrument should be used at both extremes of the arc.

2. A THEODOLITE made by BERGE. This instrument is the property of government, and was lent for Lieutenant HERBERT's use. As the telescopes were necessarily of small power, and the verniers only shewed single minutes, this theodolite though good of its kind, was only used when the circle was otherwise employed, or could not then be transported. Lieutenant HERBERT made the most of its limited powers, and as the eye may estimate a less quantity than a whole minute, he always repeated the horizontal angles on different divisions of the limb: he was obliged to observe the angles at the remote and lofty stations of *Kedar Kánta* and *Uchalarú*, with the theodolite only, which will account for the sum of the three angles between those two stations, and those of the *Chúr*, *Bairá* and *Chandpúr*, differing from 180°. rather more seconds then they ought, though less than might have been expected; as will be seen in the notes. But when there is an oppor-

tunity, the circle will be taken up to *Kedar Kánta* and *Úchalarú.* The former is 12,589 and the second 14,142 feet higher than the sea.

3. A REFLECTING circle made by TROUGHTON and marked No. 44. I did not receive this particular instrument from Mr. TROUGHTON himself, but purchased it in *Calcutta;* though substantial and perfect in all respects, it does not appear to me, to have so high a finish as the more modern circles of this construction made by that excellent artist, and though it is rather larger, I suspect it may be somewhat inferior to them. Every person conversant with reflecting instruments, knows the advantage which circles have above sextants, and it is needless to mention it here. When the altitudes of stars were observed, we always took them, on different nights, on alternate arches of the circle, and the sun in the same manner: the pole star only can be observed on both arches on the *same night:* some times indeed when a star could not be taken on both faces, the index error was used, but always with reluctance. When the weather allowed of it, the stars were taken north and south of the zenith, as equally, as to number and altitude, as circumstances allowed. It will be seen by the lists, that the observations for latitude have been very numerous. They were taken with great care: no glass roof was used over the mercury, when it was possible to dispense with it: the closest corrections for precession, aberration, nutation, and for refraction, according to the state of the atmosphere, were applied to the altitudes, which were faithfully noted. With regard to refraction, the quantities directed by the tables corrected for the barometer and thermometer were applied, but as it is not impossible that there may be peculiarities in the atmosphere on lofty mountains, which the usual rules will

not correct, we were anxious to divide the observations on both sides of the zenith as much as might be, though that could not always be effected. Those observers who fancy they can determine latitudes with portable reflecting instruments to the exactness of a second or less, will be surprised to see the discrepancies which our lists present, even at the *Belville* station, where we were not vexed by tempests and mists. It will be seen, that some of the results vary 10, 12, 15 and more seconds occasionally on both sides of the mean; but when it is considered that in an instrument of six inches radius, twenty seconds is a very small space, being only the $\frac{1}{1800}$ part of an inch, difficult for the maker to divide, and perhaps more so, for the observer to read, and that the telescopes are of small power, it seems hardly warrantable to suppose that any number of reflections can reduce the uncertainty to less than five or six seconds, nay perhaps double that quantity. Indeed if small instruments are capable of this accuracy, they do more than considering their size, can proportionably be expected from them, when we see that observations for latitude made with the most perfect zenith sectors of five and eight feet radius, and used by such skilful observers as Colonels MUDGE and LAMBTON, vary in some instances as much as eight seconds from each other, and by referring to the notes of those distinguished astronomers Messrs. DELAMBRE and MECHAIN, who in the great survey of the *French* meridian used the repeating circle, it will be seen that the results of observations for latitudes taken from the same, and by different stars and on different nights, did occasionally differ from each other, twenty and even thirty seconds: though in the use of the repeating circle, these casual discrepancies are no doubt rendered of little or no consequence, in the *mean* given by the very great number of

observations, which the peculiar construction of that instrument, enabled the *French* astronomers to take with great facility in a comparatively short time. On account of its portability and extensive power, I think the repeating circle, improved as its construction now is, by Mr. TROUGHTON, would be an excellent instrument to employ in mountain surveys: though it is true that some extra calculation is requisite to reduce the oblique angles of objects not of the same apparent altitude.

OUR *English* circles give the horizontal angles *directly*, and no correction is necessary, but when they are of great power, they are very heavy and difficult to carry in the rugged mountains, and require firmer supporters than we can always conveniently make for them. With regard to TROUGHTON'S reflecting circle, it is certainly an admirable instrument, and above all others, well suited to the purpose for which it is intended, i. e. the taking of lunar distances at sea or on shore, as well as for taking altitudes. It may be thought that we were not so successful in making use of its powers as we should have been, but it will be seen by the close accordance of the observations of latitude made with it at *Sehâranpûr*, by Lieutenant HERBERT and myself, that if we could have been as well satisfied with the results taken in the mountains, we might have dispensed with measuring the base. At *Sehâranpûr* we could observe at our ease, and the temperature was equable, but on the *Chúr* the case was widely different, and I am much inclined to think that the great difference of temperature between the two places altered, by the effect of the contraction of the metal of the circle, its identity, if I may be allowed so to term it. On the *Chúr* the cold at nights was so

severe that we were obliged to keep fires in our small tents, while on the out side our ink was frozen, and unluckily we did not think of the precaution of keeping the circle as nearly as we could at an even temperature, by leaving it on the out side of the tent when we had read off the angle. On the contrary, as soon as we had observed the meridian altitude of a star, and registered it, we laid down the circle in the heated tent, until it was time to take another star, and as that operation necessarily took up some time, the limb and verniers being of different sorts of metals, might possibly expand and contract in contrary and uncertain directions, and cause error. Such may, or may not be the cause, and in justice to the instrument I state these circumstances, though I should think there is no need to make suppositions, which may appear forced, when it is considered, that the radius of the reflecting circle is only six inches, and that exact reading by candle light is not to be expected, and that there is a great difference between observing calmly in the plains, and on the ridge of a stormy mountain, 11,529 feet above their level. At *Bairát* also the temperature differed from that at the *Chúr* and *Seháranpúr*; to say nothing of the possible uncertainties of celestial refractions on the two mountains.

FOR observing the eclipses of *Jupiter's* satellites, and thence determining the longitude of the first meridian, I used an achromatic refracting telescope of forty-two inches focal distance, and 2·7 inches aperture: it was made by DOLLOND, and had rack work and every adjustment. It was my own property. Lieutenant HERBERT used one of the same dimensions, belonging to government, it had no rack work, but was a good instrument, and also made by DOLLOND: he had also a good chronometer, public pro-

perty, made by BARAUD, and I had three very fine ones, my private property, made by BROCKBANKS and MOLINEUX. The list of longitudes annexed is important, as the first meridian is settled from twenty-four immersions and emersions of the first satellite, being a much greater number of observations than have I believe ever been taken in the upper provinces, to fix so interesting a point. It was known to the late Surveyor General, Colonel COLEBROOKE several years ago, as well as to myself, that the longitudes assigned to *Haridwar* and several places in *Rohilc'hand*, by Mr. REUBEN BURROWES, were too far to the west by about seven miles. The name of BURROWES deservedly stands high, as a learned mathematician, as well as an expert astronomer, but it is many years since he took his observations in *Rohilc'hand*, and at that time the astronomical tables were less perfect than at present, and Mr. BURROWES used a telescope of small power, and I believe took a very small number of observations of the satellites in comparison with ours. I do not presume to disparage the operations of so distinguished an astronomer, so far as his means of accuracy admitted, but it is well known that the due observation of the eclipses of the satellites, and thence determining differences of longitude, is by no means difficult to any person moderately skilled in practical astronomy, so that those who have the best modern instruments and tables, and can take the greatest number of good sights, can give the most accurate results.

THE pyramid which I built at the trigonometrical station on the *Chúr* in 1816, is the first meridian:—

Its longitude being 77°. 28'. 30".

Its latitude 30°. 50'. 36".

Height above the sea 11,529 feet,

but the highest rocky point of the mountain is 350 feet higher than the observatory.

As to barometers, we were deficient in those useful auxiliary instruments, those we had, being frequently broken: it is obvious that barometrical deductions cannot be put in competition with geometrical, conducted as the following were:—and that they cannot be used on the great snowy peaks which are not to be ascended. No barometrical deductions are admitted into this paper, except the height of *Belville* or *Sekáranpúr* above the sea, as there was no other method of determining it: I believe it to be near the truth, probably erring in defect rather than excess. I may mention however that by co-temporary observations with two barometers by Lieutenant HERBERT on the *Chúr*, and myself at *Sehàranpùr*, the difference of level comes out 11,581 feet, the true or geometrical height being by elevation and depression 11,529 feet, a trifling difference, attributable perhaps to chance. We made those barometers out of common weather glass tubes and filled them ourselves. We frequently amused ourselves by taking differences of level by the method of observing the boiling point of water as shewn by the thermometer; this when common thermometers are used, is of course only an approximation, but even with those short and imperfect intruments may occasionally be of comparative use. The results were often surprisingly close, and the greatest error we noted, was *once* about four hundred feet, on a true difference of altitude of 7000: one might expect it to be far greater when it is considered what a small quantity one degree of *Farenheit* is on a thermometer of eight or twelve inches long. I think that Dr.

WOOLASTON's improved thermometer will supercede the mountain barometers altogether. It has every advantage. I may here mention that on the 20th of June, 1816, when in the snowy pass in *Kanaur*, it occurred to me to put the thermometer to this use, which I did, and the next day, after crossing over the ridge of the *Himálaya*, I mentioned the circumstance in a letter to *England*, and observed the advantages to be derived from it, if thermometers could be made portable, with a sufficiently long scale. I was quite ignorant then of Dr. WOOLASTON's instruments, or that a thermometer had ever been thought of, as a proper instrument for measuring heights, and indeed it is very strange, how little it has hitherto been applied to the purpose.

4. THE chain which was used as a standard of comparison in the measurement of the base was made for me by TROUGHTON. It is of steel, one hundred feet in length at the temperature of 62°. and is composed of twenty links, each being five feet, they are strong and little liable to bend. It has the usual apparatus of forks and pins to keep it stretched, and index plates, intended to be fixed to a stand, to mark the termination of each chain's length. I much regret that I had not two such chains, that one might be used in the measurement, and the other kept as a standard, but as there was only one, it was thought best to use it only as a check on the cedar rods, as is fully detailed in the sequel.

THE above are the principal instruments used in the trigonometrical and astronomical operations of the survey, intended to determine the positions of the snowy peaks, but in tracing the numerous routes, and filling up the interior of the map, various instruments, adapted to the purposes, were employed, of which it is not necessary to give detailed descriptions.

I SHALL here conclude this introductory notice, which I am aware is already too prolix, and that from an anxiety to exhibit, as well the advantages we enjoyed, as the difficulties to which we were subjected, in the course of the survey, several repetitions occur: still I hope these will be excused, for in settling finally, which it is hoped the present operations (combined with Captain WEBB'S) will do, the heights of some of the principal *Himálaya* peaks, a point, on which even so great an authority, as DE HUMBOLT, has fallen into error, we have imagined, that we could not be too explicit in describing the instruments, and in detailing, not only our original observations, and the methods of calculation, but even the several steps, of the process itself, from which the results are deduced. We have been aware, that it is only this full and candid disclosure, in which many things are met with that might have been glossed over, that can give a conclusion of *so much interest*, any weight; and while we deprecate the theorists pronouncing too decidedly on the value of results, which may appear to him, much too discordant, we feel confident that in the eyes of the practised observer, who will consider the nature of our instruments, and the difficulties with which we had to contend, these very discrepancies will prove our strongest claim to his confidence.

Observed Latitudes of Stations.

1. *Belville,*—By Captain HODGSON.

Date.		*Sun or Star.*		*With what Instrument.*
1816, November,	1	Polaris, ...	29° 57′ 16″	Reflecting Circle.
	2		11·1	
	9		11·0	
	10		13·7	
	12		16·5	
	20		09·7	
	21		20·7	
	18		18·8	
	25		03·7	
	26		56 55·7	
	27		57 11·4	
	6		12·7	Circular Instrument.
	12		15·7	
	21		56 56·7	
	6 & 7		57 20·7	
		Cygni, ...	03·7	
			06·0	
		Andromeda, ...	08·0	
	11 & 12		10·5	
	6 & 7	α Pegasi, ...	16·6	
	11 & 12		19·7	
	6 & 7	γ Pegasi, ...	27·8	
	12 & 13		03·5	
	1 & 2	Sun, ...	15·2	Reflecting Circle.
	4 & 5		11·7	
	6 & 7		15·2	
	11 & 12		27·0	
	13 & 14		14·7	
	17 & 18		03·0	
	21 & 22		56 54·6	
	19 & 20		57 02·7	
	26 & 27		09·2	
1817, January,	24 & 25	Rigel, ...	10·5	
	27 & 29		16·5	
	31 & 1 Feb.		22·2	
September,	25	Atair, ...	12·6	
October,	2		11·0	
	3		16·0	
	7		09·2	
	11		05·6	
	8 & 9	Sirius, ...	07·7	
	10 & 11	Sun, ...	00·8	
November,	1 & 3		08·2	
October,	31	Polaris, ...	02·3	

Latitude of *Belville*,—Continued.

Date.		*Sun or Star.*	° ′ ″	*With what Instrument.*
1817, November,	6	Polaris,	29 57 08·9	Reflecting Circle.
October,	23		04·8	Circular Instrument.
			01·2	
November,	5	Sun,	04·5	Reflecting Circle.
			14·4	
			07·5	
			08·6	
			13·0	
			00·0	
	7		16·4	
			15·8	
			56 53·3	
			57 02·5	
			56 50·5	
			57 15·5	
			56 55·5	
		Mean,	29 57 09·5	

By Lieutenant HERBERT.

			° ′ ″	
1818, November,	20	γ Pegasi,	29 57 15·0	Reflecting Circle.
		α Cassiopeiæ,	26·2	
		α Polaris,	18·7	
	21	Sun's lower limb,	09·7	
		α Pegasi,	19·6	
		γ Pegasi,	17·4	
		α Cassiopeiæ,	18·9	
	23	α Polaris,	51·3	
		α Cassiopeiæ,	19·5	
	26	Sun's upper limb,	32·5	
	27	γ Pegasi,	25·3	
		α Cassiopeiæ,	03·4	
		α Polaris,	01·6	
	28	γ Pegasi,	04·1	
		α Cassiopeiæ,	56 54·3	
		α Polaris,	57 11·0	
		Sun's upper limb,	11·9	
		Ditto,	25·0	
December,	1	Sun's lower limb,	56 39·5	
	2	α Ceti,	57 05·3	
		α Persei,	01·5	
		Sun's lower limb,	10·1	
	3	α Ceti,	09·9	
		α Persei,	56 58·7	
		α Polaris,	57 23·1	
	4	Sun's upper limb,	17·1	

Latitude of *Belville*,—Continued.

Date.		*Sun or Star.*		*With what Instrument.*
1818, December,	4	α Ceti,............	29° 57′ 22″·5	Reflecting Circle.
		α Persei,............	46·4	
	7	Aldebaran,............	29·1	
		Capella,............	56 47·2	
	8	Sun's lower limb,..	51·0	
		α Pegasi,............	57 20·6	
		α Cassiopeiæ,........	17·9	
		α Polaris,............	05·9	
		Mean,	29 57 11·8	

2. The *Chúr*,—By Captain HODGSON.

1816,		Regulus,............	30° 50′ 01″·5	Reflecting Circle.
			09·7	
			26·8	
			32·5	
		β Leonis,............	23·1	
			13·0	
		Polaris,............	04·0	
			09·5	
		Atair,............	03·0	
			21·0	
			01·0	
		Mer. Alt. of Sun,...	17·5	
			17·5	
			05·5	
			05·5	
		Cir. Mer. Alt. of Sun,	15·9	
			21·2	
			15·9	
			21·2	
			16·3	
			16·3	
			00·2	
			00·2	
			00·8	
			00·8	
			14·2	
			14·2	
			25·7	
			25·7	
			21·4	
			21·4	
		Mean,	30 50 13·7	

Latitude of the *Chúr'*,—Continued.

By Lieutenant HERBERT.

Date.			*Sun or Star.*		*With what Instrument.*
1817,	October,	13	Sirius,............	30° 50′ 24″·4	Sextant.
				22·3	
				12·1	
				24·6	
		5		19·4	
				23·8	
				30 50 21·1	
		16	Polar Star,........	30 50 16·0	
				31·8	
				21·7	
				34·9	
				00·5	
				09·6	
				26·5	
				36·5	
				28·4	
				38·6	
				12·0.	
				14·6	
				13·9	
				25·7	
				20·5	
				30·5	
				28·2	
				11·1	
				19·1	
				19·7	
				25·8	
				36·6	
				26·3	
				15·6	
				27·1	
				25·6	
				26·2	
				27·9	
				25·4	
				29·8	
				30·1	
				12·5	
				12·3	
				04·9	
				18·6	
				26·1	
				30 50 22·6	
			α Ceti,............	30 50 07·7	

Latitude of the *Chúr*,—Continued.

Date.		*Sun or Star.*	° ′ ″	*With what Instrument.*
1817, October,	16	α Ceti,............	30 49 58·7	Sextant,
			50 04·8	
			49 53·6	
			50 15·1	
			09·5	
			09·1	
			14·6	
			21·1	
			28·0	
			17·4	
			15·4	
			15·8	
			11·9	
			13·0	
			06·3	
			30 50 11·1	
		Sun,.............	30 50 26·7	
			38·2	
			23·6	
			26·7	
			13.6	
			18·4	
			19·7	
			20·8	
			23·5	
			25·4	
			28·0	
			19·1	
			32·1	
			26·4	
			21·7	
			13·2	
			15·9	
			12·6	
			13·1	
			26·1	
			10·5	
			17·2	
			15·7	
			22·5	
			17·5	
			17·9	
			30 50 23·7	
	17	Sun,.............	30 50 28·0	
			25·3	
			20·7	

Latitude of the *Chúr*,—Continued.

Date.		*Sun or Star.*	° ′ ″	*With what Instrument.*
1817, October,	17	Sun,....	30 50 16·3	Sextant.
			15·8	
			49 58·1	
			13·1	
			03·0	
			30 50 15·0	
	18		30 50 19·1	
			19·3	
			17·4	
			13·6	
			23·0	
			21·9	
			35·5	
			26·2	
			27·3	
			29·9	
			17·8	
			24·7	
			33·1	
			23·5	
			18·4	
			18·9	
			30 50 22·2	

RECAPITULATION.

	° ′ ″
The latitude by Sirius is,	30 50 21·1
Polar Star,	22·6
α Ceti,	11·1
The Sun 16th,	23·7
Ditto 17th,	15·0
Ditto 18th,	22·2
	30 50 20·4
Place of observation S. of Pyramid +	02·1
Mean of 108 observations,	30 50 22·5

		° ′ ″	
	Polar Star,........	30 50 33·7	Reflecting Circle.
	μ Ursæ Majoris,.....	27·0	
	α Serpentis,.........	49 48·5	
	Antares,...........	50 16·5	
	α Libræ,..........	01·7	
	β Ursæ Majoris,......	21·6	
	α Serpentis,..........	18·8	
	Antares,...........	15·5	

Latitude of the *Chúŕ*,—Continued.

Date.		*Sun or Star.*		*With what Instrument.*
1817, October,	18	γ Draconis,....	30° 50′ 22″·7	Reflecting Circle.
		Polar Star,.........	11·5	
			13·8	
			02·4	
			10.7	
		Spica,.............	22.9	
		η Ursæ Majoris,.	22·0	
		α Libræ,....... ...	22·2	
		β Ursæ Minoris,......	22·1	
		α Serpentis, ...	49 52·3	
		η Ursæ Majoris, ...	50 11·3	
		α Libræ, ...	18·0	
		β Ursæ Minoris, ...	17·3	
		α Serpentis, ...	31·6	
		Antares,..........	36·4	
		α Herculis, ...	22·3	
		α Ophiuchi, ...	49 58·7	
		γ Draconis, ...	50 07·9	
		γ Aquilæ, ...	05·9	
		α Ditto,............	49 58·4	
		Spica,............	50 28·6	
		η Ursæ Majoris,.. ...	18·2	
		α Libræ,..	08·9	
		β Ursæ Minoris,.	07·6	
		α Serpentis,.........	35 8	
		Antares, ...	27·1	
		α Herculis,..........	29·2	
		α Ophiuchi,.........	13·1	
		γ Draconis,..........	11·5	
		α Aquilæ, ...	19·9	
			30 50 16·2	
		Place of observ. S. of Pyramid, ...	+ 02·1	
			30 50 18·3	

3. *Bairát.*

March,	30	α Hydræ, ...	30° 34′ 10″·1	Reflecting Circle.
		Regulus, ...	02 6	
April,	2	Spica,............	34·5	
		Antares, ...	31·5	
		Regulus,..........	10·0	
		α Serpentis,.........	05·6	
		α Ophiuchi,........	17·5	
		β Ursæ Minoris,.....	10·1	

Latitude of *Bairát*,—Continued.

Date.			*Sun or Star.*		*With what Instrument.*
				° ' "	
1817,	April,	2	α Polaris, ...	30 34 28·1	Reflecting Circle.
				35·7	
			γ Ursæ Majoris, ...	38·7	
			α Ditto, ...	19·0	
			η Ditto, ...	29·6	
			γ Draconis, ...	37·7	
		3	α Hydræ, ...	17·0	
			Antares, ...	30·7	
			α Libræ, ...	29·3	
			Regulus, ...	19·3	
			α Serpentis, ...	14·8	
			α Ursæ Majoris, ...	31·6	
			γ Ditto, ...	27·2	
			η Ditto, ...	34·1	
			γ Draconis, ...	41·9	
		4	α Ursæ Majoris, ...	34·9	
			α Polaris, ...	30·3	
			γ Ursæ Majoris, ...	52·4	
		6	Regulus, ...	10·3	
			α Ursæ Majoris, ...	30·3	
			β Ursæ Minoris, ...	27·5	
			α Polaris, ...	48·3	
			γ Ursæ Majoris, ...	38·7	
			η Ditto, ...	56·6	
		8	Spica, ...	02·1	
			Regulus, ...	31·1	
			α Ursæ Majoris, ...	30·4	
			α Polaris, ...	24·6	
				16·3	
				33·7	
				29·9	
			γ Ursæ Majoris, ...	32·7	
			η Ditto, ...	43·1	
		9	α Hydræ, ...	14·7	
			Regulus, ...	31·2	
			α Libræ, ...	24·0	
		14	α Serpentis, ...	36·9	
			β Ursæ Minoris, ...	43·7	
		15	α Ursæ Majoris, ...	41·3	
		16	Spica, ...	49·8	
			β Leonis, ...	11·3	
			α Serpentis, ...	07·3	
			α Ophiuchi, ...	42·3	
			β Ursæ Minoris, ...	53·8	
			α Polaris, ...	25·1	
				29·1	
			η Ursæ Majoris, ...	24·8	
		17	α Hydræ, ...	33 57·7	

Latitude of *Bairát*,—Continued.

Date.			*Sun or Star.*		*With what Instrument.*
1817,	April,	17	Spica,	30° 34′ 04″·1	Reflecting Circle.
			Regulus,	35·0	
			β Leonis,	29·6	
			α Ursæ Majoris,	44·2	
			η Ditto,	35·9	
			Mean,	30 34 26·2	

4. *Surkunda.*

	October,	19	γ Pegasi,	30° 24′ 27″·1	Reflecting Circle.
			α Cassiopeiæ,	01·0	
			α Polaris,	13·0	
		20	Sun's upper limb,	23 56·3	
			α Cephei,	24 35·0	
			γ Pegasi,	09·6	
			α Polaris,	23 44·8	
		21	Sun's lower limb,	53 0	
			α Aquarii,	24 00·0	
			γ Pegasi,	19·2	
			α Cassiopeiæ,	23 57·9	
			α Polaris,	24 01·5	
		22	Sun's lower limb,	23 59·0	
		23	Ditto upper limb,	51·8	
			α Cygni,	58·2	
			α Cephei,	24 18·8	
		24	Sun's lower limb,	23 51·3	
			α Cephei,	24 19·8	
			α Pegasi,	23 55·1	
			γ Pegasi,	24 09·1	
			α Polaris,	00·3	
		25	Sun's upper limb,	23 51·6	
		27	Ditto lower limb,	53·2	
		28	Ditto Ditto,	56·6	
			α Cephei,	24 20·0	
			α Aqarii,	23 56·2	
		29	Sun's lower limb,	51·5	
			α Cephei,	24 14 5	
			α Aquarii,	23 53·9	
			α Pegasi,	24 20·3	
			γ Ditto,	16·8	
			α Polaris,	09·9	
			Mean,	30 24 04·6	

Latitude,—Continued.

5. *Whartú.*

Date.			Sun or Star.		With what Instrument.
1819,	June,	17	α Libræ,............	31° 14′ 44″·7	Reflecting Circle.
			β Ursæ Minoris,......	40·0	
		18	η Ursæ Majoris,......	45·6	
			Ditto,.............	51·8	
			Ditto,.............	34·8	
			Ditto,.............	23·7	
			α Libræ,............	31·2	
			Ditto,.............	32·2	
			Ditto,.............	23·2	
			β Ursæ Minoris,......	38·6	
				39·9	
				50·6	
				46·6	
			α Serpentis,.........	46·7	
				41·1	
				43·0	
				31·8	
		22	β Ursæ Minoris,......	33·1	
				26·9	
				35·0	
			α Libræ,...........	53·5	
				37·3	
				33·5	
				32·2	
		27		09·4	
			β Ursæ Minoris,.....	47·9	
			α Libræ,...........	43·7	
				46·5	
			Mean.	31 14 38·0	

RECAPITULATION.

			°	′	″
1.	*Belville*,....	by Captain HODGSON,...........	29	57	09·5
		— Lieutenant HERBERT,........			11·8
2.	*The Chúr*,.	— Captain HODGSON,..........	30	50	13·7
		— Lieutenant HERBERT, (Sextant)			22·5
		— Ditto, (Reflecting Circle)			18·3
3.	*Bairát*,....	....	30	34	26·2
4.	*Surkunda*,.	....	30	24	04·6
5.	*Whartú*,..	....	31	14	38·0

Longitude of the 1st. *Meridian of the Survey.*

THE methods resorted to for determining longitudes being rather less susceptible of accuracy than those for determining the latitude, it has been deemed adviseable to reduce all the observations, made for the former purpose, to one point. Having thus obtained a mean result, the differences of longitude of the various places of the survey being applied to it, their absolute longitude from *Greenwich* becomes known.

IT is not our purpose here to enter into any comparison of the relative degrees of value, which the several methods of determining this point may possess. It may be sufficient to state, that finding in practice, the immersions and emersions of Jupiter's satellites, as compared with the nautical almanack, afforded us very close results, and being in possession of instruments fully equal to such a course of observations, we have naturally leaned to them, not omitting however any opportunity, when in a convenient place, of making also other observations. It would be no doubt desirable that these should be compared with others made at a place, the longitude of which is well known. This however cannot be *Greenwich*, because the number of immersions and emersions visible both in this country and at *Greenwich* is very small, and of these, few can be observed at that place, owing to the uncertain climate. *Madras* therefore naturally presented itself as more properly adapted to this purpose. The seat of an observatory of the Honorable Company, its longitude must be known to

the greatest accuracy, short of trigonometrical certainty, and the difference of longitude being so small, while the climate is equally favorable, there was a likelihood of finding a corresponding observation for every one made here. It was with these ideas, that a list of a number of the immersions and emersions of Jupiter's satellites, was forwarded to the Company's Astronomer Mr. GOLDINGHAM, who very readily furnished us with his own observations of the same phenomena. A second list was afterwards sent, but his answer has not yet been received, and as in the first the number of observations is in no degree comparable to the total number made, it has been thought most adviseable for the present, while waiting a more correct determination, to present here the results obtained from a comparison with the Ephemeris. It is to be noted, that whatever error may be occasioned in the longitude, as deduced from emersions, owing to want of power in the telescope, will be counteracted by an equal error in a contrary sense affecting the immersions—so that supposing the tables tolerably correct—a mean of the results of emersions and immersions, will we think be found not far removed from the truth.

THE differences of longitude are in most cases found either wholly, or the chief part, trigonometrically. In a very few instances, and for very small distances, the route survey checked and corrected, is necessarily taken. The error in this part of the calculation can in no single case amount even to 4", and on the mean must be insensible.

Immersions of Jupiter's 1st. Satellite.

Date.			*Place of Observation.*	*Longitude of 1st. Meridian.* H. M. S.
1814,	March,	9	*Dêhra*,	5 09 42
1817,	April,	10	*Geiráh*,	5 09 56
		17	*Sicri*,	5 09 20·9
			Khursali on the *Jumna*,	5 09 22·6
	May,	10	*Reital* on the *B'hágirathi*,	5 09 48·0
		12	Ditto Ditto,	5 09 54·5
			Chacarwara,	5 09 52·8
1818,		5	*Nahan*,	5 09 33·3
1819,	April,	18	*Bel* in *Jounpúr*,	5 09 21·6
		25	*Kalsí*,	5 09 26·5
	June,	3	*Saura* on the *Tonse*,	5 09 50·0
	July,	5	*Kotgher*,	5 09 48·2
1820,	May,	6	*Bysúli* in *Bangerh*,	5 09 52·2
		22	*Nyural* in *Bamand*,	5 09 57·6
			Mean of 14 Immersions,	5 09 41·9

Emersions.

1814,	April,	25	*Dêhra*,	5 09 30
	May,	2	*Bhadraj*,	5 10 09
		18	*Belville*,	5 09 37·2
	July,	13		5 10 23·2
		30		5 09 53·8
	August,	14		5 10 06·2
		21		5 10 02·3
1816,	May,	9	*Nahan*,	5 10 13·6
	June,	17	*Trandeh* in *Kanaur*,	5 10 06·3
1817,		13	*Súkhea*,	5 10 01
		30	*Nyural* in *Bamand*,	5 10 25·9
	August,	21	*Dêhra*,	5 10 06·7
	September,	6		5 10 09·9
			Belville,	5 10 31·2
	October,	15		5 10 18·3
			Dêhra,	5 10 11·2
1819,	August,	13	*Kotgerh*,	5 10 13·3
	September,	21	*Ronlan* on the *Paber*,	5 09 45·9
	October,	23	*Nako* in *Hangarang*,	5 10 03·8
		30	*Súnnam* in *Kanaur*,	5 09 53.2
	November,	8	*Nahar* in Ditto,	5 10 04·1
		15	*Nirt* on the *Setlej*,	5 09 54
	December,	1	*Kotgerh*,	5 09 53·4
		8	*Kotli* in *Bágal*,	5 10 06·5
1820,	November,	9	*Saháranpúr*,	5 09 42·3
			Mean of 25 Emersions,	5 10 05·9

Longitude by 25 Emersions, 5 10 05·9
14 Immersions, 5 09 41·9

Mean longitude of 1st. Meridian, 5 09 53·9 = 77° 28′ 28″·5

or in even numbers say, 77° 28′ 30″

An account of the measurement of a Base Line of 21,754·8 feet.

BY LIEUTENANT J. D. HERBERT, 8TH REGT. N. I.

CAPTIAN HODGSON having in what precedes, referred to me for an account of the manner in which the task that devolved on me, (in consequence of his bad state of health) of measuring a base, has been executed; I propose in what I have to say, first, to give a brief description of the instruments and methods of using them; and to subjoin a table containing the particulars of the measurement, with the resulting length as properly reduced. These are to be followed by details of a small triangulation, founded on the base; with the length of one of the great lines determined therefrom.

IN the execution of this measurement, I had to contend with great difficulties; owing, to the want of assistance. I am of opinion however that the error of the measurement, does not exceed two feet; an uncertainty which will only affect the distances of the most remote peaks, by about sixty or seventy feet. As the fruit of my experience, I may mention; that I would not attempt a similar operation with wooden rods, without such metallic additions, as should detect and register the alteration in their length, arising from atmospheric changes.

IT may be thought that with a chain such as has been described in Captain HODGSON's account of the instruments, there was required little consideration, as to the mode to be followed—all that was necessary, being to

have coffers and stands made for it. But the employment of the chain in this way would have evidently consumed an immense period of time, not only in the operation itself, but still more, in the preparation of the coffers and stands, the latter requiring to be made with elevating screws. This alone was a sufficient objection; even supposing the great delay it would have caused, none. For in this remote part of the country one such stand could not be properly executed, if at all, without incredible difficulty. What then would have been the case when there were twelve or fourteen to be constructed. To this must be added the consideration, that I was alone in a work which requires at least two to execute it properly. From the beginning therefore I relinquished the idea of employing the chain— except as a standard of comparison, for which purpose it was invaluable.

2. WHEN I had rejected the chain it appeared that the best substitute would be a set of rods constructed of pine wood; the comparative unalterability of which has been long known. Such rods have been employed by some philosophers in the measurement of a degree, particularly by LA CAILLE and General ROY. It is true that General ROY rejected the measurement made with them, in consequence of the changes which he found the greater or less quantity of moisture in the atmosphere produced in their length, yet when we look at the small error which a re-measurement of this base with glass rods detected, we shall be satisfied that for the purpose I contemplated, pine rods are capable of sufficient accuracy. He found the difference between the two measurements only two feet, and this in a distance of $5\frac{1}{2}$ miles, and I certainly thought so small an error as this, could never be alleged as an objection to the success of my operation.

indeed I had laid it down, that if I could obtain a degree of accuracy, which would leave not more than an uncertainty of one foot in 5000, it would be as much as I could hope for, and sufficient to ensure all the advantages, for the attainment of which the measurement was undertaken.

3. THE next point was to settle in what manner the rods were to be constructed. This was of course, to depend a good deal on the nature of the stands which could be obtained. General ROY's rods were twenty feet in length, and trussed vertically, and laterally to prevent bending—pieces of ivory, with fine *lines* drawn on them, being inserted in the extremities for the purpose of making the contact perfect. The method of contacts was however found to consume too much time, and metal buttons projecting from the ends of the rods—were made to butt against each other. In using rods of this description, heavy stands with elevating screws were indispensible. These I have already noticed were out of the question, and therefore this mode of construction was necessarily abandoned. Foreseeing from the first, the great time that it would cost to prepare stands of any description, I had contemplated the possibility of doing without them, and in the following manner:—Supposing a number of stout pickets driven into the ground at distances of twenty-five feet, I thought a rod of this length, well trussed, and furnished with points, forming in some measure a large beam-compass, might be used for setting off accurately this length from picket to picket. This method would have been sufficiently expeditious, and would have required hardly any apparatus; but on mature consideration I feared it would be attended with more error than is allowable. The measurement being conducted so near the ground would have occasioned great

uneasiness in the position, and it is well known how essential an easy position is to correct operations of every kind. In using points too far laying off the length of the rod, it was evident, that a little uncertainty would prevail. The great length would have made it also unwieldy, and where the position of one of the points was necessarily to depend on the intelligence, and care of a native, it was feared that much accuracy could not be expected. This idea was therefore abandoned, but I have thought proper to notice it here, not only to shew the difficulties I had to contend with, but also as thinking it might be found useful on other occasions, where only a tolerable degree of correctness may be desirable.

4. ALTHOUGH I saw the inconvenience of points, acting as I was without a coadjutor, yet I did not immediately give up the pickets; indeed the objections and difficulties that interfered with any plan depending on stands, were strong motives to do if possible without them. I therefore considered, if the method by pickets might not be so far modified as to be executed by contacts instead of points. I recollected the apparatus which the *French* philosophers had employed on a similar occasion, where they had used metallic rods, placed in a line, but not in actual contact, the shock of the latter being supposed likely to cause considerable errors. To determine the distances of the rods or rulers, there were small slips of metal sliding in grooves called by them *Languettes*, and furnished with verniers, by means of which they could determine the exact quantity between the rods to the greatest nicety: such an apparatus I saw was applicable to wooden rods, supported on pickets, placed nearly but not quite in contact. In this way the position would be much easier, and the accuracy of the work

depend less on it. Indeed so unexceptionable did this plan appear, that I determined at once to employ it; and the only motives that afterwards induced me to change my mind, were, the insufficiency of the seasoned wood, I had brought down from the mountains to construct three trussed rods of that length or even two; and a hope, that by another method which I had just fallen on, I should be enabled to get through the work still more expeditiously than by this, particularly as I should lose less time in the preparatory operations. This new method which was the one finally employed, I now proceed to give an acconnt of.

5. THE piece of wood out of which I was to construct the measuring apparatus, was twenty-six feet in length and about six inches by four. It was a piece of that beautiful species of pine, called by DR. ROXBURGH *Deodara,** the wood of which the mountaineers consider indestructible. It had been taken out of a dwelling house which had fallen into decay, and as the houses in that part of the country last a very long time, this piece, which had served as a beam, could hardly fail of being well seasoned. Being so small however, it was quite out of the question to have more than one trussed rod out of it, and as I saw that with less than three rods, the measurement could not be depended on, I resolved to dispense with the trussing, by which means I should have four of twenty-five feet each, making one hundred feet or an equivalent to the chain. A rod twenty-five feet in length, and $1\frac{3}{4}$ inches by $1\frac{1}{4}$ (as I was obliged to construct it), it may be easily conceived, must be considerably too pliable. It was therefore

* THIS is undoubtedly the *Pinus Cedrus* or *Cedar* of *Lebanon*. HODGSON.

necessary to have them supported at distances of 6¼ feet. The plan I hit on for constructing these supports, was I think happy; allowing as it did, great facility in laying and adjusting the rods of the same hypothenuse, being favorable to expedition, requiring little art in the making, nor much timber, nor even that well seasoned, and above all, being such as might be quickly constructed.

6. THESE supports are represented Plate I. figs. 1 and 2. They consist of an upright, of from six inches to three feet in length, fashioned square, to within two inches of the bottom, where it has six equal faces: on the alternate ones, are inserted legs at right angles, in all three, and these legs are each armed with a strong iron prong for taking hold of the ground, when laid for the rods. These uprights are about three inches square, and there is a levelled groove on one face, reaching nearly the whole length in which slides loosely, a piece, having its upper end fashioned into a fork (fig. 3) the prongs of this fork are broad, but short and separated about three inches. It is in this fork that the rod is to rest.

7. THIS sliding fork is to be steadied, when brought to the proper height by means of thin wedges driven between it, and the sides of the groove in which it slides. The uprights being of three sizes, six, eighteen and thirty-six inches, and the stems allowing of a correct adjustment to all the intermediate heights, it is evident that these supports are equal to all the inequalities of ground, that can possibly occur, and this I found to be the case, carrying on many of the hypothenuses to 1000 feet, and this on a surface so very unequal as the *Dún*, the fall of which too in four miles is between three and four hundred feet.

8. THE rods which are rectangular prisms twenty-five feet in length, and $1\frac{1}{4}$ by $1\frac{1}{4}$ inch; were meant to be placed in pairs; the two pairs being separate, and one remaining fixed, while the other pair should be brought forward. To support each pair of rods, nine stands were required, being placed at distances of $6\frac{1}{4}$ feet. Thus for the four rods, were wanted eighteen, and nine to be laid ready for the rods that were to be next brought forward, to which adding ten more, five large and five small for unexpected inequalities, the total number is thirty-seven. Though this be a large number, yet the quickness with which they are constructed, more than makes amends, so that where wooden rods are used, I do believe it to be one of the most convenient methods of supporting them that I have any knowledge of.

9. THE rods which formed the pair, were placed interlocking (fig. 4) the ends being cut to allow of that arrangement. But the pairs being placed separate, so as to allow of having a fixed point on the ground; required some means of measuring the distance between them. I adopted the same method as that alluded to (art. 4). The fixed or hinder pair had attached to their anterior end, a brass *cheek* projecting $\frac{1}{2}$ inch beyond the wood, to which, it was secured by two screws, passing through the rod, and clamped with nuts. The fore pair again had attached to their upper surface a brass plate on which a groove was fashioned, a slide moved freely in this groove and could be pushed out so as to touch the fore edge of the brass cheek belonging to the hinder or fixed pair of rods. The quantity being measured by a *Nonius*. This apparatus is represented by fig. 5.

10. THE rods being so long and thin were necessarily extremely pliable, so that supposing the forked slides of the stands to be laid quite correctly in the hypothenusal plane and the rods consequently adjusted in one sense, still it was by no means likely they would be correct with respect to the vertical plane; without which it is evident the distance between the extremities of the rods must be continually changing. To guard against this error a brass wire about $\frac{1}{40}$ of an inch diameter, was stretched along the middle of the rod, sufficiently light to leave no doubt of its straightness of direction. At convenient distances small flat bridges were attached to the rod of the same height as the wire, and in their middle a narrow groove of about $\frac{1}{10}$ of an inch. The rod was easily brought into such a position by means of small wedges pressing against the prongs of the forked slides, that the wire lay freely in this groove without touching either side of it. The rod was then known to be straight. This wire had also a second use, and no inconsiderable one. The forked slides were to be brought in to the hypothenusal plane by a boring telescope, placed on the hinder rod, the adjustment being made by means of a small cross of wood, the transverse piece of which was fixed at exactly the same height as the cross wires of the telescope, when placed on the rod. But it was found that this manner of adjusting the forks was not entirely satisfactory, as there was always a trifling deviation in most of them. The reason of this will appear evident if it be considered that the slides being raised or depressed by jirks, were necessarily very difficult to be got quite correct. This difficulty had been foreseen from the first, and indeed the chief object of the wire was to correct this defect. Although it be certain, mathematically speaking, that no wire or cord stretched between two supports can ever be perfectly

even or free from a slight bend downward: yet when the tension is great, and the weight of the string little, its deviation from the line joining its two extremities, may be so small, as to be inappreciable by sense. The brass wires already mentioned were thin, and they were stretched by a weight a little short of the maximum, they were capable of bearing. They may therefore be supposed to have been rectilineal.* The small bridges already noticed being of the same height as the wire at its extremities, and the groove allowing of the wires being depressed in the case of the rod lying uneven, it was seen immediately by the position of the wire, whether the rods were situated in the intersection of the hypothenusal and vertical planes, and if not they were easily brought into the required position by means of the small wedges already noticed, applied under and on either side of them. Perhaps it will be said, that this method was troublesome and consumed time; no doubt it did: but certainly not so much, as the employment of trussed rods and stands with elevating screws would have done—and indeed when my people began fairly to understand what was meant, I got through the work quick, and found on passing along the line of rods hardly ever cause to touch the adjustment myself. Fig. 6, represents this contrivance on a large scale.

11. IT has been already noticed how small the error of pine rods was found by General ROY. His method however of comparing the rods, several times during the day, with a standard, was in some measure

* ALTHOUGH the truth of this be evident, and that it was confirmed by experience, yet it may be well to notice here, that supposing the wire to have fallen in the middle, below the straight line $\frac{1}{4}$ of an inch, which it certainly did not, the error in the length of the rod would be only $\frac{1}{7600}$ of an inch.

the reason. As I had neither the facilities nor the funds to allow of my conducting the operation in the same style, I saw that some check was required, to guard against any very great change in the length of the rods. To compare them several times a day, would have been a means of delaying excessively the operation, especially as having no one I could depend on, to afford me any assistance, added to which, I had no materials of which to construct the standard rod, except wood, and then I had no means of guarding it against the effects of the weather. It is true there was the chain, (and an invaluable standard of comparison it proved) but to have compared the rods with it daily, even once, not to say several times, would have caused so much delay, as must have deprived me of all hopes of finishing the work, within any reasonable period. To lay off the length of the chain it was necessary to insert firmly into the ground, a draw and a weigh post, and this consumed much time: again without stands and coffers, it was the work of half a day to get the chain correctly laid. It was indeed a consideration of these difficulties, that made me originally abandon the idea of using the chain in the measurement, and yet in practice, I found them much greater than I had imagined. As therefore it was quite out of the question, comparing the rods often with the chain, I thought of the following plan of detecting any changes in their length, arising from variations of temperature or humidity.

12. THE original idea of this plan was unexceptionable, and if it had been executed, would have stamped the measurement with every appearance of accuracy. Unfortunately however I was tempted to modify it, in consequence of some difficulties that occurred, and by this modification an

uncertainty* has been occasioned, small it is true, but still greater than need have been. My first idea was to attach to the wooden rods, thin iron or brass slips, either of an equal length or something shorter—by means of which, and a thermometer, it might be seen whether and how much the wood had been affected in length. The modified plan was to construct a machine, which I afterwards distinguished by the name of a *comparator*, and by means of which, I thought the changes which the wood might undergo, would be detected with as much certainty as those in metal, by means of the thermometer. In forming this judgment I overlooked however a very essential difference—the homogeneity of the metal, and the want of that quality in the wood, which circumstance causes so much uncertainty, that judging from experience I would say, that no two pieces of wood will lengthen and contract in the same manner and degree for any length of time. Fig. 7, (Plate II.) gives a view of this *comparator*, as finished, and figs. 8 and 9, explain certain parts referred to, in the following description.

13. IT consists of a frame of wood, supported on four legs, strengthened by cross pieces, so that in lifting, no alteration of figure takes place. To this frame is screwed a wooden piece eight feet in length, and of the same thickness and breadth of the measuring rods, represented by figs. 8 and 9. To it is attached, about an inch above it, a brass cylindrical rod of the same length, by brass rings which screw into it. To the last ring marked *a*, the

* ABOUT two feet.

brass rod is firmly fastened: in the others, it plays loosely, and is free to expand or contract. The end *b* has a pin *c* passing through it vertically, which presses against an index of brass *d*, that moves over a graduated arc, and thus points out the alteration in the relative lengths of the wood and brass, from time to time. The absolute change of length in the brass being known by the thermometer, and the received rates of expansion, it follows; that the actual change of length in the wood becomes also known. It is hardly necessary to mention, that the wooden piece A B is only fastened at one end, being free to contract or expand between wooden studs that prevent its warping.

14. THE index *d* is kept up to the pin, when the brass is contracting, by means of a small spring, which in every situation keeps it in accurate contact with the pin. The point where the pin presses, is within $\frac{1}{2}$ an inch of the centre of motion, while the index extends 12 inches beyond it. By this means the minutest changes are discovered, being increased in a ratio of 24 to 1, and such was the sensibility of the instrument, that scarcely for 10 minutes did the index ever remain stationary. This instrument I called a *comparator*, because it served to compare the length of wood, with that of brass, and therefore to detect any changes in the former. As the wooden rod of eight feet (A B fig. 8), was cut out of the same piece of timber as the measuring rods, I did at first imagine that it would prove a very satisfactory means of doing away the objections to wooden rods, arising from the effects of the weather in altering their length. The result was not however answerable to my expectation.

15. THE remainder of the apparatus, consisted of a plummet and tripod, for marking the point on the ground, where the measurement left off, and allowing it to be found readily the following morning. Fig. 10 is a representation of this. The piece A B being moveable in the direction of the groove *a b*, and also turning readily on the screw c as a centre, was easily brought into that position, in which, a notch cut in the piece of ivory, *d*, should correspond exactly with the wire of the plummet suspended in water, and hanging from the tripod of a theodolite, placed in advance of the rod. The distance of the wire from the rod was determined by means of an ivory scale. This plummet was also useful, when it became necessary to rise or fall at the commencement of a new hypothenuse.

16. THE flags which were used to *align* the base, and the pickets which were put down to mark every 500 feet, had nothing remarkable or requiring description. The flag staff (fig. 11) 48¾ feet in height, which marked one extremity of the base, consisted of two pine spars perfectly straight, and joined together by means of an iron collar. It had four braces to set it truly perpendicular, which was done by means of a plummet weighing two pounds. When adjusted, the stress was on the braces, and not on the stags.

17. THESE comprised the whole of the apparatus used, with the exception of the boring telescope, which was one, having a power of about six, with cross wires. The theodolite mentioned in the account of instruments, was used in determining the inclination of the several hypothenuses—the observation being made on both faces, and the circle in the alignment of the

base. As the instrument answers as a transit, and is well known, there is the less occasion to say any thing, as to the manner of employing it.

18. THE base having been aligned and cleared, and large pickets, numbered regularly, driven into the ground, every 500 feet, I commenced the measurement on the 2d. February, by laying the first pair of rods in contact, with the wire of a plummet, brought carefully over a point on the picket, marking the extremity of the line. So many difficulties attended the operation at this early stage, while none of my people understood clearly what was required from them, that to lay this first pair of rods occupied me nearly an *hour*, although afterwards, when more perfect, ten minutes generally sufficed, and frequently the pair was adjusted and entered in six minutes. I found that I was even myself a little confused at first, before I had completely settled the arrangement, by which I was to proceed in the different operations which I had to perform. For these reasons I was not sorry to find afterwards when I came to observe the angles, that it was necessary to reject a small piece at the commencement, I had, after marking out the base, wished to add to it. This piece was remarkably low, the declivity being about 5°, and when the circle was set up, it was found impossible to view the flag staff at the other extremity. In the first instance, the base had been marked out, and the extremity fixed, as finally chosen, and in going on with the measurement as commenced from a point 450 feet back, it was most carefully noticed, by what quantity, the end of the last of the rods falling here, overshot the large picket, which had been driven into the ground, to mark the originally chosen extremity. The measurement of this 450 feet, which comprehended more difficulties than any other portion of the

base, served as a kind of exercise, to instruct us fully in the nature of what was to be done, and enabled me to determine precisely the method, in which I was to carry on the operation. As it has been rejected, there is no occasion to give the details, but I thought proper to notice the circumstance, to shew that when the line finally chosen, was actually commenced upon, we had acquired some degree of practice as well as confidence.

19. BEFORE entering upon the details of the measurement, I may briefly notice the order in which the several parts of the operation were performed. A cross of clean fir $3\frac{1}{2}$ feet in height, was first set up at the distance of 500 feet, being placed on the picket, in advance, forming a point in the alignment of the base. The stands were then ranged as near as the eye could judge, in the direction of it, and their distances regulated by a rod of the proper length: by means of a small stick of fir, with a cross vane, held by one of the people in the fork of the stand; three of them (that is the two outer and middle one), were brought correctly into the alignment, with a boning telescope resting on the preceding pair of rods. The small stick carrying the vane, being made to cover the cross, resting on the picket, by moving the stand to right or left as might be required. The forked stems were at the same time regulated, as to height, by bringing the cross vane, to cover the transverse piece of the cross on the picket, which had been originally regulated to the height, at which, it was thought the hypothenuse could be best carried on. The telescope was mounted on a wooden bed, which gave it an elevation of about three inches, above the surface of the rod. The cross vane of the small stick used for adjusting the forks of the stands, was set to such a

height as was equal to this quantity,+ the depth of the rods. From this arrangement the line traced through the air, and the inclination of which was observed, was really above the surface of the rods, three inches, but parallel to it, and care was therefore taken, before removing the first set of rods of any hypothenuse, to adjust the theodolite on a stand with an elevating screw, so that the height of the axis of the telescope, when directed to the transverse piece of the cross placed on the picket, should be exactly equal to this quantity. Three stands out of nine (the number required for a pair of rods) being thus adjusted, that is the two *outer and the* middle one—both as to the alignment and hypothenusal direction, the others were quickly brought to correspond by means of a strong twine stretched along the nine. The stands being moved to right or left, and the forks raised or lowered till they were all so adjusted, that the twine lay in the middle of the forks and barely touching them. The hinder pair of rods were now brought forward, to be laid on the stands previously adjusted. It has been already noticed in the description of the rods, that the two pairs were perfectly independent of each other, and generally one inch asunder. This afforded a sufficient precaution against the fixed or fore pair being moved, in bringing forward the hinder, but to guard against the possibility of such a thing, which would have vitiated the whole operation, I determined to trust to no one but myself, in a matter of this kind, and I therefore never allowed the hinder rods, after being adjusted, and read off, to be touched without being myself present, at the junction of the two pairs, to be satisfied, that in removing them, no shock or derangement had happened to the fore pair. In like manner, in laying this hinder pair in advance of the other, I was equally particular in seeing,

that nothing of this kind had taken place, and this attention, so necessary, to give any certainty to the operation, I never omitted.

20. THE rods being now placed on the stands, which had been previously adjusted, being near the truth, a few minutes sufficed to set them perfectly correct. For this purpose the same telescope was used, and a small piece of wood placed on the rod; the top of which had the same height above it as the axis of the telescope. This was made to correspond with the cross on the picket, by means of small wedges pushed underneath, or on one side of the rod. Such an adjustment was only required for the fore end of the advanced rod, and for the junction of the two; the other parts were easily brought right, by means of the brass wire stretched on them.

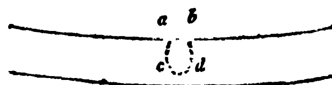
21. THE rods lying now truly on the line of the base, and in the hypothenusal plane, the languette was pushed out to meet the fore end of the fixed pair, and the reading entered in the book. The interlocking *Nonius* of the pair was next read and entered, and then the *Comparator* with the thermometer. When it became necessary to change the direction of the hypothenuse, and before the last pair of rods of the old hypothenuse had been removed, the inclination was observed with the theodolite, which had been originally set to the proper height as before noticed. The angle of elevation was observed on both faces, and the theodolite always carefully levelled, and as the instrument is capable of measuring vertical angles to a minute, there can be no great chance of error, involved in the reduction, depending on this element.

22. IN leaving off the work in the evening of each day, it was of the first importance, that the point indicating the termination of the day's measurement, should be so marked, as to leave no probability of its being displaced, and also to allow of the work being resumed readily the following morning, and without error. These two particulars were I think perfectly answered by the plummet and tripod already described. The plummet which weighed two pounds, and was attached to a brass wire, being suspended from a theodolite stand, was set so nearly touching the brass edge of the fore rod, as to leave little more than $\frac{1}{60}$ of an inch, between: the quantity, was easily and correctly estimated by means of a scale of equal parts, held behind the rod and wire. When the wire was perfectly steady, the nick in the ivory piece of the tripod, (well fastened into the ground) was set exactly to it, the manner of doing which will be readily understood from the description already given of it. A cordon of stands united by ropes was then placed all round, the rods also being left standing. And a sentry was posted, and during the night regularly relieved, to guard the tripod from the approach of any animal. The examination in the morning however never detected any thing wrong, and therefore on this head I think we may have the most perfect confidence.

23. DURING the measurement there occurred one accident, and two omissions, which compelled me to measure twice the distance, in two of the three cases, from the last passed picket. As I never omitted to notice and register the quantity, by which any rod overshot or fell short of these pickets, they formed a series of fixed points, to which I could return with the greatest confidence, in case of any part of the measurement, beyond

them, being vitiated or doubtful. The accident was the falling of a chair against the fixed pair, after the hinder pair, of rods had been removed. As they suffered some shock and were certainly moved a little, I returned to the picket, last passed and continued regularly the measurement from it. One of the omissions was the forgetting to read the languette of a pair of rods. Inconsequence of which I also thought it necessary to return to the last passed picket. The other omission was of less consequence. The quantity which had been omitted to be registered, was that by which the plummet had been placed in advance of the rods, in marking the point, where the day's work concluded. As this quantity seldom exceeded $\frac{1}{60}$ of an inch, the plummet being always placed as close as could well be to the rod, it was not thought that a doubt of such a quantity on a base of four miles, was a sufficient reason to undertake so troublesome a task as the remeasurement of 400 feet would have proved.

21. DURING the measurement, one pair of rods (being cut from the outside of the piece of wood) had warped considerably inconsequence of which I was forced to straighten them in the following manner:



THE small piece *a b c d* was cut out at the bend, and another something larger driven in, and this expedient proved a perfect cure for the warping, rendering this pair of rods equally straight with the other. Fearful, however that such an operation might have some effect on their length.

I immediately afterwards compared this pair with the other, which had not been touched, by substituting them, alternately between two fixed points. The trial was satisfactory, and proved they had not altered their length by any sensible quantity.

25. THIS base was measured twice roughly, before commencing the correct measurement, and after finishing it. The operation, each time was performed with a *Gunter's* chain of sixty-six feet, compared with a wooden rod, the length of which had been laid off from the brass scale. The length by these two measurements came out 21,766 and 21,746. The true *measurement* as reduced to the level of the sea, and temp 69^{o}—is 21754·8—So that the mean of the above two would come very near the truth. At all events their near agreement with it shews, that no material error or omission had been committed.

26. BEFORE deducing the real length of the line from the details given in the accompanying paper, some thing must be said of the manner of determining the length of the rods. There were two methods, which presented themselves either to compare the four rods placed together with the chain, or to lay off twenty-five feet by means of the brass scale, on one of them, and compare the other three with it—as a check on the operation. I determined to try both methods and it is satisfactory to find that they agreed so nearly—the difference between the two values thus independently obtained, amounting only to eight feet, on a distance of four miles. As however Mr. TROUGHTON had omitted to mention, either in

what temperature of the brass scale, (standard) the chain had been laid off, as also with what weight it was precisely equal to 100 feet, I prefer abiding by the result of the comparisons with the brass scale, more especially as they were so numerous.

27. PREVIOUSLY to commencing the measurement, the length of the rod 1.2 was laid off seven times. A beam of wood with metal points, ground down to the 600th part of an inch was used. 43 Inches were taken and laid seven times by the method of dots, and arcs, making thus 301 inches. For greater accuracy studs of ivory had been let into the wood, on which the arcs could be drawn. The beam was compared a second time with the scale, after the stepping was concluded, and $\frac{1}{2}$ the difference, if any, applied as a correction. The thermometer was noted before and after the mean taken—the same of the comparator. When the arc, which cut the line of division on the ivory scale—did not happen to be in the line of steps, an equation was applied by dividing the square of the deviation, by twice the length of the step, (eighty-six inches). The following table will shew the result of these seven comparisons. As determined by the division on the ivory scale, forming the determination of the 301 inches, and when they are reduced to the same state of the comparator, (the ratio of reduction being 1 to 2·125) the differences do not appear great except in one case, that of the 26, which may I think for this reason be rejected, particularly as the great and sudden rise of temperature, (15°) during the operation, induce an apprehension, that the brass scale might not have answered to the mean state, and that therefore, the reduction for temperature has been overrated.

Indeed if we suppose this to have been the case, this determination will be found to agree with the others as well as can be expected.

Date.	Thermometer.			Equation on 301 in. 40th of an inch.	Equation of beam.	Deviation from line of steps.	Observed term of 301 inch.	Reduced to 62°.	Comp. mean.	Reduced to 1217.
	Before.	After.	Mean.							
1819, Jan. 23	60	58	59	+·037			16·01	16·047	1238	16·062
24	43	47	45	+·211	+·035		15·78	16·026	1366	·130
25	54·5	62	58·3	+·093	+·014	+·026	16·00	16·133	1155	·090
			66	—·049			16·083	16·034	1287	·083
26			41·5	+·254	+·003	+·040	15·929	16·226	1382	·340
27	23·9	25·7	24·8	+·437	+·037	+·028	15·643	16·164	1157	·122
			34·2	+·346	+·028	+·028	15·800	16·146	1099	·063
Mean, rejecting that of the 26th,									1217	16·092

THE extreme difference of the 6 is ·068 division or ·017 inch, on 301 inches.

28. THE operations by which the lengths of the other three rods were determined, cannot be made so clear as the preceding for want of divisions on the ivory scale, which at this stage of the business had only been attached to the rod 1.2. The detail will therefore be rather more summary, the rod marked 2.3 was measured twice, the steps being made on the ivory studs. The length of the rod as defined at one end by the brass edge, at the other by an arc drawn on ivory was,

	Inches.	Comp.
	300·9601	1173
	·9413	1168
Mean,	300·9507	1170

29. THE two rods were now compared with each other. Being tied firmly with pieces of wood of the same thickness between them, they were

laid on five timbers planed exceedingly true, and supported each on two stands. They were then adjusted by the wires of both the rods. The ends of the apparatus were towards each other, and to be sure that these corresponded a T. square was applied to the cheek of one rod, and the languette of the other pushed out to meet it.

		Inches.
The Nonius read off was, ...	3·80	
Reversed it was, ...	3·93	
Mean, ...	3·865	349
Equation of rod,*		004
		345

By this quantity the rod 1.2, was in advance of 2.3. Now an arc of 43 inches radius, described from a point in 2.3, short ·0088 of the mark defining 300·9507 inches, cut 1.2 at the division 14·405; adding the quantity above given, 345 inches=1·380 divisions, we get 15·785, which is the point where the arc would have cut, had the other ends of the rods been placed even.

Now let *e d* be the line in which the centre of the arc *f a c* was found: Let *e g* be the line of divisions or 1.2, and *a* the point which formed the limit of 300·942 inches.

a e measured, 42 inches.
And c *d* ditto, 2·04

* THE cheeks of the rods were not quite parallel to their axis; the error was found, and this is the correction due to it.

From the data, and the radius, 48 inches, we get,

	$fd =$	·104839
	$fe =$	·10021
Consequently	$ed =$	·0463

Now a was the mark of 300·9419 inches.

Therefore $a\,b$ or c was,	300·8956 or on 1.2—15·758		
Add,	·1044	=	·444
Consequently, ...	Inches. 301·0000	= to	16·202 divisions.

30. A SECOND comparison was made, in which arcs were drawn from both rods, and great care taken: the result, which to avoid prolixity it is not thought necessary to detail, was that the 301 inches, on 2.3 corresponded with the division,......... 16·118

By the preceding,	·202	
Mean,	16·160	Comp. 1170
b measures on 1.2,	16·092	1217
Mean of 8,	16·109	1203

THE difference of the above results when reduced to the same state of the comparator, is only ·009 inches. From the mean, we also get the length

of the 2.3 rod, as limited by the mark, before noticed 300·966 inches. Comparator 1203.

31. THE remaining two rods were now compared with these, for which purpose they were all four placed together, 1.2 and 2.3, being on the outside of the other two. Two arcs were described with a radius of 43 inches from centres in the prolongation of the line of the divisions, parallel to the axis of the outer rods. Both arcs sprang from the same points on 2.3, i. e. the line marking the limit of 300·966 inches; Comparator 1203: with the several measures, accurately determined, were calculated the places where a line perpendicular to the axis of the 2.3 rods, and drawn through this point, would cut them. The distance of this imaginary line from certain points on the ivory scales of the rods, was also found. This line cut No. 1.2 at the division, 15·60

Add languette,	·564
	16·164
Now the mark of the 301 was, ...	16·109
Excess above 301 inches, ...	·055 = 014 in.

Comparator being 1203.

BUT it has been seen, that this line limited on 2.3 the 300·966 inches. Comparator 1203. On 1.2 .... 301·014

Difference, ·048

THE error, occasioned by the want of parallelism of the rods. This requires an equation for the intermediate rods, and it is easily found, being

proportional to the distance of their axis, or rather of the line of divisions parallel to their axis.

ON the 3.4 rods, this imaginary line was found to be from the 1.2 arc 3665 inches=1·466 divisions. These are intersected at,

	1.2	2.3
	0·035	2·114
Add,	1·466	0·628
The defining line intersected at,	1·501	1·486

THE mean of these which only differ ·004 inch is 1·493, the division on which, the imaginary line would cut 3.4. But this requires a correction as above indicated, which is found to be nearly ·031 inch. Now the length of 2.3 as defined by this line was, 300·966

	Add, $\frac{375}{590} + 048 =$	·031
		300·997
	Deduct languette,	·141
Length of rod as defined,		300·856
By the division,		1·493 Comparator being 1203.

32. IN the same manner was the length of 4.5, found to be (as limited by a certain mark) 300·919 inches. The difference of the determina-

tion from the two arcs was only ·005 inches. The rods of each pair, were now placed interlocking as they would be in the measurement. In the pair 1.2—2.3 it was found that the line on 2.3 which was most convenient for comparing with the Nonius, was ·707 short of the mark, defining the limit of 300·966 inches. This line therefore marked the extent of 300·259 inches; again the 301 inches being marked in 1.2 by the division 16·109, it is evident that the division 16 marked the termination of 301 — $\frac{109}{4}$ = 300·973 inches. Adding these, 300·973

300·259

The sum is 601·232 which is therefore the value of this pair of rods when placed interlocking, and the zero mark of 2.3 corresponding with the 16·000 division of 1.2. To find the division corresponding to 600 inches, or 50 feet, deduct 1·232 inches = 4·928 divisions, which gives us 11·072, also the 11th division answers to 599·982 inches.

33. For the other pair it was found that the zero line of 4.5 was 1·947 from the mark, forming the limit of 300·917 inches. The zero line therefore was the measure of 298·970 inches. Now on the 3.4 rod it has been seen, that the division 1·493 marked the extent of 300·856 inches, the first division therefore marked, 300·979

298·970

Sum, 599·949

When therefore the zero line of 4·5 considered with the first division of 3·4, the length of the pair was 599·949, and if the division corresponding to 600 inches or fifty feet be required, we have 1·000—051+4=796 division. The comparator being at 1203.

34. THE preceding operations were all performed previously to the commencement of the measurement. There was also a comparison made with the chain, at the same time, but for a clearer view of the subject it will be better here to go on, and give an account of other determinations of the length of the rods made during the measurement of the base from the brass scale. There were in all 8—in 3 of which the four rods were placed together, and the stepping made at once for all 4. In the other 9, only the pair 3.4 and 4.5 was measured, but we can easily from those determinations deduce the length of all four, by means of comparisons made between the two pairs. These it will be proper to notice first.

35. THE pair 3.4—4.5 had a similar ivory scale, as that of 1.2—2.3 that is to say divided into quarter inches, and each of those into tenths. During the measurement however it broke, and got loose, and it became necessary to apply another. The first point is then to determine the correspondence of the two scales, which may be done from the following double readings.

Old Scale.	New Scale
·720	·315
·740	·330
·728	·310
·570	·240

·633	·263
·725	·315
·720	·308
·670	·295
·740	·319
·595	·250
·710	·313
·723	·315
·725	·313
·700	·300
·470	·220
·730	·335
16)10·899	4·741
·681 Answers to	296

The value of the divisions on the new scale is ·054.

36. Two comparisons of the pairs were made by substituting them between two fixed points. By the first the following result was obtained

1.2—2.3		Inches.	3.4—4.5		Inches.
Languette,	$\frac{4}{90}$	= ·453	Languette,	$\frac{2}{86}$	= ·305
From fixed point,		·060	From fixed point,		·079
		·513			·384

Thus the pair 1.2—2.3 was less than 3.4—4.5 by ·129 inches.

	1.2–2.3	3.4–4.5 New Scale.
The Nonii marked,	0·663 and	0·309
Now ·129 inch = divisions,	·516	
Consequently, ...	1·179 corresponds to	0·309 New Scale.

The other comparison which was made as before noticed, after the straightening of the rods gave as the result.

1.2—2.3	3.4—4.5 Old Scale.	New Scale.
1·315	0·470	0·220

Now from the operations formerly detailed, it was found that the correspondence of the Nonii was as follows:

1.2—2.3	3.4—4.5
1·072	796 Old Scale.

These three expressed in the 3 scales will stand as follows:

	1.2—2.3	3.4—4.5 Old Scale.	New Scale.
	1·179	0·709	0·309
	1·315	0·470	0·220
	1·072	0·796	0·339
Mean,	1·189	0·658	0·289

37. HAVING thus established the relations which the several scales bear to each other, we can from the length of one pair deduce that of the other, and consequently of all four rods. The following table shows the resulting length as deduced from the several operations performed with the

brass scale. They are all reduced to one certain division of the ivory scales that is to 1·300 (1.2—2.3) 0·547 or 0·237 (3.4—4.5, Old Scale. New Scale.).

A

Length of the Rods.

Month.	*Date.*	*Pair* 1.2—2.3	*Nonius.*	*Pair* 3.4—4.5	*Nonius.*	*Length of the set.*	*Comp.*	*Reduced to* 1141 *Comp.*
						Inches.		Inches.
February,	13			599·917	0·645 O.	1199·882	988	1200·026
	16			599·936	·650 O.	1199·924	1023	·035
	21			599·905	·320 N.	1199·900	900	·128
	23			600·001	·284 N.	1200·054	1064	·126
	25	599·910	0·776	600·160	·315 N.	1200·243	1328	·066
	27	599·970 *	0·775	599·970 *	·240 N.	1200·073	1209	·009
March,	2	599·890 *	·700	599·890 *	·335 N.	1199·987	1106	·020
	3			599·920	·285 N.	1199·892	1046	1199·981
Mean of former 4 determinations, ...						1200·119	1203	1200·061
Mean of the whole, ...						1200·049	1141	
or feet, ...						100·0041		

THE extreme difference in the above, as reduced to the same state of the comparator, is only ·147 inch, on 100 feet, or ·012 feet. Half this quantity or ·006 feet, may be taken as the extreme probable error on the mean result, that is $\frac{1}{17000}$ of the whole or on the base 1.2 foot.

38. IN making the comparisons with the chain, the latter was placed upon boards, supported by the rod-stands; a draw post of 5 feet in length, driven firmly into the ground, held it at one end; at the other it was stretched by a weight attached to a rope, passing over a pully in the weigh post.

* IN these two operations the pairs were measured together, the quantities inserted in the columns are half the length found for the 4 rods.

Besides these two, there were other two posts driven firmly into the ground, on which the brass registers were set, and by means of the slider with the fine line, the length of the chain could be accurately laid off. The stands were first put accurately in the same plane by means of the small cross of wood, and the boning telescope, and any deviation which was afterwards observed, owing either to their slides having slipped or to any unevenness in the boards, was corrected by means of thin wedges placed underneath the chain. The links being 5 feet long, however were the less liable to accomodate themselves to the triffing inequalities of the boards.

39. BEING laid accurately it was thought advisable to observe its contraction and expansion, and whether it agreed with the indications of the thermometer, allowing for its change of length according to the known law. Thus being stretched by a weight of 19 lbs. and the registers set, the mean of 4 thermometers was 58·6: on the temperature, rising to 69·3, as shewn by the mean of the same thermometers, it was found that it overshot the registers or had expanded ·073 inches.

Now the expansion of a steel chain was found by Colonel MUDGE's experiment, to be very nearly the same as given in General ROY's table, in the 1st Vol. Trigonometrical Survey. This is ·0075 inches for every 1° of Fahrenheit on 100 feet,

Now, $\cdot 0075 \times 107^{\circ} = \cdot 080$ inch.

Observed expansion — ·073

Error, ·007

WHEN the temperature had sunk to 58°·0 as shewn by the four thermometers, it was found that it had contracted ·097.

Now, ·0075 × 11·3 = ·085

Observed, ·097

·012 Error.

Again the registers being set when the temperature was 57·9, it was found next morning to have contracted ·1625 inch. The temperature had fallen to 38·3.

Now, 57 — 9 — 38·3 = 19·6 and ·0075 × 19·6 = ·147

Observed, ·162

·015 Error.

40. THE registers being now firmly fixed and the chain stretched with the small weight, it was proposed by means of it, to determine the distance of them. For this purpose the quantity which the chain exceeded, or fell short of them, with the temperature as given by the four thermometers, was noticed from time to time. The chain is said in Mr. TROUGHTON's letter, to have been exactly 100 feet in the temperature of 55°. It was therefore reduced to this temperature. The following table, will shew the result:

Mean of 4 Thermometers.		Reduction to 55°.	Difference of chain.		Excess above 100 feet.
80·0	×	·187	—	·125	·062
66·2	×	·084	—	·015	·069
38·2	—	·126	—	·172	·046
38·5	—	·124	—	·191	·067
38·1	—	·125	—	·180	·055
					·069

The brass registers are therefore distant by the mean of these trials, ... 1200·069 inches.

Deduct* error of chain, ·013

1200·056

As compared with the chain reduced to 55°, and stretched by a weight of 19 lbs. avoirdupois.

When 19 lbs. additional were put on, the distance of the registers was as follows:

Mean of 4 Thermometers.	Reduction to 55°.	Distance of registers exceeding chain.	Excess above 100 feet.
38·1	·125	·165	·040
38·3	·125	·162	·037
58·0	·022	·000	·022
		Mean,	·033
		Deduct,	·013

Distance of the registers, 1200·020

The distance therefore is 1200·020 inches, as measured by the chain: reduced to the same temperature of 55°, and stretched by a weight of 38 lbs. the difference is ·027 inch, or 002 feet, on 100 = $\frac{1}{50000}$.

41. THE rods were now substituted for the chain between the registers. Fine brass wires were stretched across at right angles, at the register marks

* OCCASIONED by the irregularities of the table on which it was stretched. This equation was calculated.

to limit the length on the rods. The several verniers and scales being read off or measured were as follows:

Order in which the rods were placed, 4.5 3.4 2.3 1.2

		Inch.
The rod 1.2, overshot the brass wire or register mark, by		·134
The rod 4.5, by		·812
Total overshot,	+	·946
Deduct from languette or distance between 3.4 & 2.3,		1·011
Rods fall short of register,		·065 inch

	1.2 – 2.3		3.4 – 4.5
The Nonii were,	0·855	—	0·580
Zero divisions,	1·300 inch.		0·547
	0·445 =	·111	= 0·033
		·008	
		·119	

IF the Nonii had marked 1·300 and 0·547, the rods

	Inches.
would have been,	·119 longer.
Deduct above deficiency,	·065
Rods longer than registers,	·054

Now the registers it has been seen, were a part 1200·047 Inches. as measured by the chain at 55°, and stretched by a weight of 19 lbs. or 1200·020 as

stretched by 28 lbs. Supposing what is most probable, that the length of the chain was adjusted from the standard brass scale, when at the same temperature of 55°, we get its length in $62^{\circ} = 100$ feet —— $\cdot 01237 \times 7^{\circ} =$ 100 Feet. — 037 Inches. = 1199·913 Inches., and the distance of the registers consequently 1199·96 inches, that is supposing the chain stretched by a weight of 19 lbs. But the rods it has been seen exceed the registers by ·054 Inches. Their length will therefore be 1200·014 Inches. Comparator being 1093. This operation was performed before commencing the measurement.

42. THE second comparison was made on the 8th February. The register heads had remained fixed in the same position in which the former comparison had been made, although there was no reason for suspecting any derangement, yet it was thought proper to verify them, and by a mean of several comparisons, their distance was found, the chain being reduced to 55°, and stretched by weights of, 14 lbs. 28 lbs.

	14 lbs.	28 lbs.
	1200·072	1200·036

THE rods were then substituted between the registers over the zero lines, of which silk threads were stretched at right angles, to the axis of the rods, and the rods were found to be less than the registers, ·174 Inches.

	1.2—2.3		3.4—4.5
Now the Nonii were, ...	0·703	&	0·303
Zero divisions, ...	1·300		0·237

—·597 = ·149 Inches — 0·066* = ·036 Inches.

The sum of these is, ... ·185 Inches.

* THE divisions of this Nonius were as was before remarked, reckoned in a reverse order.

With the Nonii therefore at, 1·300 & 0·237, these rods would have exceeded the registers, by ·011 Inches.

The comparator was, 1171 at commencement, 94 at conclusion, mean, 1183.

The distance of the registers has been found 1200·072 Inches. as measured by the chain, reduced to 55° and stretched by a weight of 14 lbs. or by one of 28 lbs. 1200·036: making the reduction to 62° on the same principle as before, these become 1199·985 & 1199·949; and adding the excess of the rods, ... ·011 ·011

We have,	1199·996	1199·960

as the length of the rods, when the Nonii marked 1·300 & 0·237, and the comparator 1183.

43. Thus the length of the rods

	Inches.		
was by one operation, ...	1200·014	& 1199·987 Comp.	1093
By the other, ...	·996	·960	1183
Mean, ...	1200·005	1199·974	1138
The mean of the comparisons with the brass scale, ...	1200·049	....	1141
Difference, ...	·044		

This difference would produce on the whole base an effect of ·8 ft. But I have the less hesitation in rejecting the results of the comparison

with the chain, as I am ignorant in what temperature it had been adjusted, with the brass standard. And I think the difference of its length with different weights, (the maker having omitted to state with what weight it had been found to be exactly 100 feet) affords another, and a valid reason for adhering to the brass scale in preference. It is however satisfactory to observe that the difference of two determinations so entirely independant of each other, does not amount to 1 foot on a distance of 4 miles.

44. IT now only remains to give the several reductions of the base, and from the details to conclude the real length as reduced to the level of the sea, and a temperature of 62°.

		Feet.
First 217½ sets of rods × 100·0041 (Feet.)	=	21,750·9
Deducted over lapped, ...		17·6
		21,733·3

The sum of all the Comparators is, 460·920
1141×217·332×2 = 495·950

Difference, 35·030

$$\frac{35{\cdot}030}{2} \times {\cdot}95$$ —— 1.4

	Inch. = 16·640	21,731·9
Sum of reductions by horizontal line, ...		2·6
		21,729·3
Sum of 8th column, ...		·2
Carried forward, ...		21,729·1

		Brought forward,	21,729·1
The sum of the Nonii of 1.2—2.3 is,	176·022		
The number of the pairs was 219 which being multiplied by 1·300 the zero division gives, ...	284·7		
The difference, ...	108·7		
	—— ÷ 4	= 27·7 Inches. =	2.3
The Nonii of 3.4—4.5 old scale,		= 54·722	
No. of rods = 81 × ·547 the zero, ...		44·307	
		10·415	
		—— ÷ 4 ÷ 12 =	0·2
New scale, ...		44·404	
135 pairs × ·237 the zero, ...		31·995	
		9·409 × ·054 ÷ 12 =	0·4
			21,726·2
The languettes of 1.2—2.3		1709 7·4 ×	14·6
3.4—4.5		1939 0·0 ×	16·4
			21,757·2
Reduction to level of the sea, ...			2·4
Length of the base reduced to level of the sea and temperature 62°,			21,754·8

THE last reduction is the only one which requires any explanation. The difference of level of the stations of *Zephyr Hall* and *Belville*, was found from the peak *Surkunda* to be .... 1922 feet,

Zephyr Hall above *Newada*, ...	492	
Newada above *Belville*, ...	1430	
Newada above south extremity base, ...	186	
	1244	above *Belville*.
South extremity of base half difference, level of 2 extremity of base, ...	163	
Belville above level of the sea, ...	986	by Bar. obs.
Middle part of base above sea, ...	2303	

FROM this with the radius of the spheriod for lat. 30° 17'—(The latitude of the middle point of the base)=20,903·416 feet, the above correction has been calculated by the usual formula.

$$B - b = B \times \left(\frac{h}{r} - \frac{h^2}{r^2} + \frac{h^3}{r^3} \text{ \&c.}\right)$$

where B means the measured base,

C ———— corrected,

h The height above the level of the sea,

r The radius of the spheroid.

IT is evident that the first term $\frac{h}{r}$ is sufficient for practical purposes.

§. 2.

1. HAVING finished on the 2d of March, the measurement of the base, I proceeded immediately to fix on stations for deducing from it the length of one of the principal lines, the distance of *Surkanda* and *Chandpúr* peaks. That distance as finally determined, was found to be 225582 feet, and their elevation above the *Doab* respectively, 8258 and 7548 feet.

To connect these distant points by establishing stations between, I found a very arduous task, and the difficulties I had to contend with, were so great, that the last or 15th station was not finished till the 14th of May.

2. ON the proper disposition of such a triangulation, as much as on the measurement of the base, depends the accuracy of the final result. It has been given as a rule to choose the triangles, as nearly equilateral as possible, and this is no doubt proper, when the correctness of each point may be equally desirable. But, as it is difficult to find stations so conveniently situated, and as the series generally is required to continue only in one direction, it seems allowable to admit of small angles, when no principal link of the chain depends on them.

3. IN enquiring what may be the probable error in the distance finally deduced from this triangulation, we have to consider first the probable error of the base, and secondly the errors of the angles arising from the want of power in the instrument, or ability in the observer. The former I have stated at probably not exceeding two feet. The angular instrument has been already described. It is no doubt a very fine one. With a teles-

cope of great magnifying power, and verniers reading to 5″ it does appear, but a fair supposition, that angles could be observed to that degree of accuracy. The divisions are however on brass, which renders them difficult to read with certainty. However judging from the extreme error in the sum of the three angles, and supposing it to be the same way on every angle of the three, we shall get 7″ as the extreme possible error on each angle. Now if we take an equilateral triangle, (not too favorable a supposition), we shall find that this error on each of the two angles used in concluding the new side, and supposing them to be in the most unfavorable sense, would *only* affect the result by $\frac{1}{25\cdot000}$ part of the whole. But even in a few triangles, this error ought in a great measure to correct itself, so as to prevent the error increasing in the ratio of the number of the triangles.

4. Now the closing station is brought in at the 14th triangle, and if all those that only answer as checks be rejected, it will be but the 10th in order. This would appear to be a sufficient warrant against any great accumulation of error, but I have as a check chosen to follow out the result by other series. The 35th figure, furnishes the 3d value of the distance of the two principal stations *Surkanda* and *Chandpúr*; the mean of the three values, is taken for the foundation of the large triangulation. Those after the 35th, are meant from some of the preceding results, to deduce the distances of the intermediate stations of the great triangulation, and in one case, by means of a concluded angle. But this result is checked again by one of the great triangles.

5. NONE of the angles on the sine of which any connecting side depends is less than 40°, except in one triangle, (the 15th) and in this the angle is 16°, but from this a very short side of 17,000 feet only is concluded, as part of a longer side of 58,000, from which the series was to continue. The reason of requiring this small side; (the distance of the 12th and 13th stations), was an inability to distinguish the 13th station from the 10th. I was therefore obliged to make a quadrilateral of the 10th, 11th, 12th and 13th. The distance of the 11th and 13th is checked by 2 other quadrilaterals, in which other stations were substituted for the 12th. I have numbered these in the order of the triangles. This method of deducing a side, from the known angles and all the sides, but one or two, of a 4, 5, or 6, sided figure is very convenient, and I think equally satisfactory, as the more direct one of a triangle. I have therefore not hesitated to employ it, as in the figures marked 23, 26, 28, 31, 33.

6. WHAT follows consists of,—first, a detail of the angles observed at each station with an account of the stations, and the reductions to the centre where required. To this, I have subjoined a table of the angles reduced and arranged in triangles or quadrilaterals, with all the logarithms, necessary for their verification. It would appear to be affecting an accuracy, of which operations (conducted with such limited means as ours), are not susceptible, to have used more than 6 figures of logarithms. In fact on an angle of 60°, an error of 7″ would produce an alteration of 8, in the 6th figures of the sine. And on a line of 21,000 feet, the error of two feet, which I suppose possible, might alter the logarithm 4 in the 5th place. So that 6 figures appear to be more than sufficient. The

known sides of the triangles are always on the third or last line. The heading of the columns is sufficiently intelligible. Some triangles are resolved by cosines, for instance, when 2 sides and 3 angles are given, those angles being very acute, that is less than 30°. In resolving 4 sided figures, the general method that has been followed is to draw parallels to the 2 unknown sides—by which means 2 triangles are obtained, in which all 3 angles are given, and one side. In resolving a 5 or 6 sided figure I have preferred, letting fall perpendiculars, from each of the angular points on the unknown side, and calculating the several sides or pieces, intercepted by these perpendiculars. But from the paper itself it will be sufficiently clear, how each result is obtained, and from the full detail that is given, it will be an easy task to detect any mistakes that may have been made.

Detail of the Angles of the Triangulation founded on the measured Base.

In the following there has been no selection nor rejection, but where it was quite evident, that the wrong object had been bisected. There are three columns, one for the various readings on the same point of the limb, the other for the various means of these, and a third for the true or correct angle.

1st Station, Southern Extremity of the Base.

		Readings on same point of Limb.	*Readings on different point.*	*Mean or correct value of the Angle.*
		° ′ ″	° ′ ″	° ′ ″
1	Flag staff, *Newada*,	98 26 48·7		98 26 30·7
		38·8		
		42·5	98 26 43·3	
		22·5		
		30		
		20		
		37·5		
		22·5	26·5	
		11·2	11·2	
		45·6	45·6	
		26·8	26.8	
2	Flag staff and *Zephyr Hall*,	22 40 55·5		22 40 51·0
		45		
		52·5	22 40 41·0	
3	*Zephyr Hall* and *Newada*,	75 45 18·8		75 45 31·1
		37·5		
		21·2		
		47	75 45 31·1	

2d Station, *Newada.*

		Readings on same point of Limb.	*Readings on different point.*	*Mean or correct value of the Angle.*
1	Base subtends,	49 21 19·1	49 21 19·1	49 21 14·0
		11·2		
		11·8	11·5	
			05·7	
			32·5	
			11·4	
2	Southern extremity of the base and *Zephyr Hall*,	71 37 33·7		71 37 39·0
		43·7		
		56·2		
		37·5	71 37 42·8	
			35.3	

2d Station *Newada*,—Continued.

		Readings on same point of Limb.	Readings on different point.	Mean or correct value of the Angle.
		° ′ ″	° ′ ″	° ′ ″
3	Northern extremity of the base and *Nalapaní*,	22 17 58·5		22 18 05
		18 16·5	22 18 07·5	
			02.5	
4	*Mitha Bérí* and *Nalapaní*, ...	74 03 46·2	74 03 46·2	74 03 47·8
			49·4	

3d Station, *Zephyr Hall.*

1	The base subtends, ...	50 49 58·7		50 49 56·8
		50 12·5		
		49 58·8	50 50 03·3	
		50 49 47.7		
		53·8	49 50·7	
		50 50 00·0		
		49 52·7	49 56·3	
2	*Newada* and southern extremity of the base, ..	32 36 36·3		32 36 40·6
		26·3		
		41·2	32 36 31·6	
		32 36 46·3		
		42·5	32 36 41·4	
		32 36 38·8		
		47·5		
		42·5	32 36 42·9	
3	Northern extremity of the base and *Nalapaní*,	96 43 20.0		96 43 18·3
		12·5		
		16·2	96 43 16·2	
		96 43 24.8		
		25 0	96 43 24 9	
			96 43 13·8	
4	*Newada* and *Nalapaní*, ...	180 09 55		180 00 57·1
		51·3		
		56·2	180 09 54·2	
		180 09 58 8		
		10 01 3	180 10 00·0	

4th Station, *Nalapaní.*

1	*Zephyr Hall* and northern extremity of the base,	57 51 37 5		57 51 40·6
		42·5		
		39·9	57 51 40·0	
			41·2	
2	*Newada* and northern extremity of the base, ..	57 59 57·5		57 59 59·3
		62·5		
		60·6	58 00 00·2	
			57 59 58·5	
3	*Newada* and *Mitha Bérí*, ...	58 08 51·2		58 08 42·0
		43·8		
		48·5	58 08 47·8	
			36·1	

4th Station, *Nalapaní*,—Continued.

		Readings on same point of Limb.	Readings on different point.	Mean or correct value of the Angle.
		° ′ ″	° ′ ″	° ′ ″
4	*Mitha Béri* and *Dúdhilí* station,............	67 26 33·8		67 26 31·9
		37·5		
		35·2	67 26 35·5	
			28·3	
5	*Dúdhilí* and *Masírana* station,............	51 32 07·5		51 32 09·1
		06·5		
		07	51 32 07·0	
			11·2	
6	*Masírana* station and *Surkanda*,............	47 53 20		47 53 21·8
		23·5		
		20·2	47 53 21·2	
			22·5	
7	Tank and *Dúdhilí* station,................			66 44 40
8	Tank and *Bhadraj Dún*,................			56 59 04·1
9	*Bhadraj* and *Dúdhilí* station,............	9 45 33·8		9 45 35·6
		37·5		
		35·5	9 45 35·6	
10	*Bhadraj* and *Masírana* station,............	61 17 41·3		61 17 42·6
		44		
		42·5	61 17 42·6	
11	Tank and *Masírana* station,................			118 16 47

5th Station, *Mitha Béri*.

1	*Dúdhilí* station and *Nalapaní*,............		65 23 44·0	65 23 57·8
		65 24 12·5		
		10·6	65 24 11·5	
2	*Nalapaní* and *Newada*,................		47 47 37·1	47 47 43·2
		47 47 37·5		
		40·0	47 47 38·8	
			47 47 53·8	

6th Station, the Tank.

1	*Dúdhilí* station and *Nalapaní*,............		56 02 59·4	56 03 01·0
		56 03 08·8		
		02 56·2	56 03 02·5	
2	*Bhadraj* and *Nalapaní*,................		72 43 51·3	72 43 55·7
			44 00·0	
3	*Timli* and *Bhadraj Dún*,................		85 18 52·4	85 18 48·1
			43·8	
4	*Bhadraj* and *Dúdhilí* station, (1 from 2).....			16 40 54·7
5	*Nalapaní* and *Masírana* station,............	26 35 05·0		26 35 04·[illegible]
		03·7	26 35 04·4	
6	*Bhadraj* and *Masírana* station,............			46 08 49·7
7	*Nalapaní* and *Timli*, (2 from 3)..........			158 01 43·8

7th Station, Northern Extremity of the Base.

		Readings on same point of Limb.	Readings on different point.	Mean or correct value of the Angle.
		° ′ ″	° ′ ″	° ′ ″
1	*Nalapaní* and *Zephyr Hall*, ...	25 25 10		25 25 03·8
		02·5	25 25 06·3	
		25 25 07·5		
		07·5	07·5	
		25 24 53·7		
		25 01·3	24 57·5	
2	*Nalapaní* and *Newada*, ...	99 42 00		99 42 02·3
		41 58·8	99 41 59·4	
		99 42 14·8		
		42 13·7	42 14·3	
		99 41 47·5		
		58·8	41 53·2	
3	*Zephyr Hall* and S. extremity of the base, ...	106 29 18·7		106 29 12·9
		07·5	106 29 13·1	
		106 29 21·3		
		20·0	106 29 20·7	
		106 29 05·8		
		03·7	106 29 04·8	
4	*Newada* and southern extremity of the base, ..	32 12 06·2		32 12 08·3
		11 57·5	32 12 01·8	
		32 12 14·0		
		13·8	32 12 13·9	
		32 12 12·0		
		06·2	32 12 09·1	

8th Station, *Timli.*

1	Tank and *Bhadraj Dún*, ...	41 25 46		41 25 46·8
		41		
		54	41 25 47·7	
			41 25 46·0	
2	Tank and *Bairát* flag staff, ...	61 21 55		61 21 54·3
		52·5	61 21 53.7	
			61 21 55	
3	Tank and *Bhadraj-Jaunsar*, ...	66 19 08·7		66 19 05·6
		02·5		
4	Tank and *Surkanda*, ...		18 28 27·5	18 28 30·5
			33·5	
5	*Bhadraj Dún* and *C'handpúr*, ...	68 52 49·5		68 52 44·9
		45	68 52 47:3	
			42·5	
6	*Bairát* flag staff and *C'handpúr*, ...	48 56 39·5		48 56 36·0
		37·5	48 56 38·5	
			33·5	
12	*Bairát* fort and *Bhadraj Dún*, ...	2—1		19 56 07·5
7	*C'handpúr* and *Surkanda*, ...		91 50 07	91 50 00·8
			49 54·5	
8	*C'handpúr* and *Chúr*, ...	14 08 20·5	14 08 26·5	14 08 34·5
		32·5	42·5	

8th Station *Timli*,—Continued.

		Readings on same point of Limb.	Readings on different point.	Mean or correct value of the Angle.
		° ′ ″	° ′ ″	° ′ ″
9	*Surkanda* and *Chúr*,	105 58 27·5	105 28 27·5 37	105 58 32·3
10	*Chúr* and *Bairát* flag staff,	63 05 00 00		63 05 00
11	*Bhadraj-Jaunsar* and B. F. S.			4 57 09·9

9th or *Musírana* Station.

1	*Nalapaní* and *Surkanda*,	92 03 25 24·3 26·5		92 03 25·3
2	*Nalapaní* and *Dúdhilí* station,	77 57 40 32·5		77 57 36·3
3	*Nalapaní* and *Bhadraj-Jounpúr*,	119 13 26		119 13 26
4	*Nalapaní* and tank,	35 03 06·2		35 03 06·2
5	*Dúdhilí* station and *Bhadraj-Jounpúr*,	41 15 39·8		41 15 39·8
6	*Bhadraj-Jounpúr* and tank,	84 10 19·8		84 10 19·8

10th Station, *Surkanda*.

1	*Nalapaní* and *Musírana* station,	40 03 13·8 17·5 40 03 33·5 41·8 31 40 03 25·5 29	40 03 15·6 40 03 35·4 40 03 27·3	40 03 26·1

11th Station, *Bhadraj-Jounpúr*.

1	*Bhadraj Dún* and *Musírana* station,	93 37 35 32·5		93 37 33·8
2	*Bhadraj Dún* and *Bairát* flag staff,	61 14 52·5 58		61 14 55 3
3	*Bhadraj Dún* and *Bairát Math*,	67 26 55 60		67 26 57·5
4	*Musírana* station and *Bairát* flag staff,	154 52 27·5 30·5		154 52 29
5	*Bairát* flag staff and *Bhadraj Dún* old station,	59 39 11·2 16·8		59 39 14

12th *Dúdhilí* Station.

1	*Mitha Bírí* and *Nalapaní*,	47 10 47·5 53·7		47 10 50·6
2	*Mitha Bírí* and tank,	9 57 26·3		9 57 26 3
3	*Nalapaní* and *Bhadraj Dún*,	138 24 45 55 138 24 53·7 47·5	 138 24 50 138 24 50·6	138 24 50·3

12th *Dúdhilí* Station,—Continued.

		Readings on same point of Limb.	Readings on different point.	Mean or correct value of the Angle.
		° ′ ″	° ′ ″	° ′ ″
4	*Nalapaní* and tank,	57 08 08·8 12·5	57 08 10·6 25·0	57 08 17·8
5	*Nalapaní* and *Masírana* station,	50 29 01·2 28 52·7		50 28 57·4
6	*Masírana* station and *Bhadraj Dún*,	171 06 20 12·6		171 06 12·0
7	Tank and *Bhadraj Dún*,	81 16 38·7 41·2	81 16 40·0 81 16 30·0	81 16 35

13th Station, *Bhadraj Dún.*

		Readings on same point of Limb.	Readings on different point.	Mean or correct value of the Angle.
1	*Nalapaní* and *Dúdhilí* station,	31 50 17·5 25		31 50 21·3
2	*Nalapaní* and *Bhadraj-Jounpúr*,	85 49 51·2 53·1		85 49 52·2
3	*Nalapaní* and tank,	50 11 51·3		50 11 51·3
4	*Timli* and *C'handpúr*,	69 54 34·3 37·5		69 54 35·9
5	*Timli* and *Bairát* flag staff,	109 07 51·3 47·5		109 07 49·4
6	*Timli* and *Bairát Math*,	104 25 58·8 55·6		104 25 57·2
7	*Bhadraj* old station and *C'handpúr*,	31 34 49·3		31 34 49·3
8	*Bhadraj* old station and *Bairát* flag staff,	70 48 06·3		70 48 06·3
9	*Bhadraj-Jounsar* and *Bairát* flag staff,	28 35 57·5 36 08·8		28 36 03·2
10	*Bairát Math* and *Bhadraj-Jounpúr*,	66 16 12·5 17·2		66 16 14·8
11	*Bairát* flag staff and *Bhadraj-Jounpúr*,	61 34 20 16·9		61 34 18·5
12	*Bhadraj-Jounpúr* and *Dúdhilí* station,	53 59 33·7 28·7		53 59 31·2
13	Tank and *Timli*,	53 16 11·2		53 16 11·2
14	Tank and *Bhadraj-Jounsar*,	133 47 52·4		133 47 52·4
15	Tank and *Bhadraj-Jounpúr*,	136 01 44·4		136 01 44·4
16	*Dúdhilí* station and tank,	82 02 16·3		82 02 16·3

14th Station, *Bhadraj-Jounsar.*

		Readings on same point of Limb.	Readings on different point.	Mean or correct value of the Angle.
1	*Bairát* flag staff and *Bhadraj Dún* new station,	76 20 17·5 22·5		76 20 20
2	*Bairát* flag staff and *Timli*,	150 54 46·3 56·3		150 54 51·3
3	*Bhadraj Dún* new station and *Timli*,	74 34 28·8 33·8		74 34 31·3

15th Station, *Bairát* Fort.

		Readings on same point of Limb.	Readings on different point.	Mean or correct value of the Angle.
		° ′ ″	° ″	° ′ ″
1	*Bhadraj-Jounpúr* and *Bhadraj* new station, ..	57 10 88 12·5		57 10 10·7
2	*Bhadraj-Jounpúr* and *Bhadraj* old station, ..	59 11 33·8		59 11 33·8
3	*Bhadraj-Jounpúr* and *Timli*, ...	108 06 01·3 15		108 06 08 1
4	*Bhadraj-Jounpúr* and *Surkanda*, ...	6 03 17·5 27·5		6 03 22·5
5	*Bhadraj* new station and *Bhadraj* old station,	2 01 23·8		2 01 23·8
6	*Bhadraj* new station and *Bhadraj-Jounsar*, ..	75 02 16·3 08·3		75 02 12·5
7	*Bhadraj* new station and *Timli*, ...	50 55 51·3 56·3		50 55 53·8
8	*Bhadraj* old station and *Surkanda*, ...	53 08 16·3		53 08 16·3
9	*Bhadraj-Jounsar* and *Timli*, ...	24 06 25 12·5		24 06 18·7
10	*C'handpúr* and *Timli*, ...	75 22 26·9 18·5		75 22 22·7
11	*C'handpúr* and *Surkanda*, ...	177 25 10·7 06		177 25 08·3

16th Station, *Bairát Math*.

1	*Bhadraj-Jounpúr* & *Bhadraj Dún* new station,	46 17 30 26.2 15		46 17 23·7
2	*Bhadraj-Jounpúr* and *C'handpúr*, ...	175 21 16.5 30		175 21 23·3
3	*Bhadraj Dún* new station and *C'handpúr*, ... 2—1	129 03 57.4 04 11.3		129 01 04·4

17th Station, *C'handpúr*.

1	*Bairát* right corner and *Timli*, ...	55 42 42·5		55 42 42·5
2	*Bairát Math* and *Timli*, ...	58 37 58·8		58 37 58·8
3	*Bhadraj Dún* new station and *Timli*, ...	41 13 30		41 13 30

Account of the Stations, at which the foregoing Angles were observed, and details necessary for their reduction to the centre of the Station.

THE greatest part of these stations are either on rising grounds or on the summits of peaks. Indeed there are but four out of 17, which are on the low grounds. The signals used were, in the *Dún*, and where other objects did not offer, pyramidal frames of wood covered with cloth. These when projected on a dark ground, are very distinguishable, and can on account of the sharpness of their summits be intersected, with the greatest nicety. Their axis were set truly perpendicular by means of a plummet and wedges driven underneath them. This plummet was also made to coincide with the centre of the station, and the signal then fixed by driving in strong pickets to which it was lashed. For two stations, the northern and southern extremities of the base, a flag staff was used and after concluding the angles in the *Dún*, this flag staff was erected at the connecting station in the *Dún*, in order that it might be more distinguishable from the mountains. The other objects observed were various as will be seen in the following account of the stations. I shall give also the reduction of the observed angles, to the true, as referred to the centres of the several stations.

1st Station, Southern Extremity of Base.

A LARGE picket was driven in to mark this station. The signal was placed immediately over it as also the circle in obcerving. There are therefore no reductions to be made.

2d Station, Newada.

THE same as the first station, it is about 100 feet west or north-west of the *Math* or *Hindú* temple, near the village of that name, four miles south-east of *Déhra*.

3d Station, Zephyr Hall.

THE same as the two preceding. It is near the north-west corner of Captain YOUNG's *Bungalow*, on the *Nalapaní* Hill, distinguished by the above name.

4th Station, Nalapaní.

THIS is the site of the fort of that name, before which General GILLESPIE fell. The station is marked by a large picket (Plate 3, fig. 1). In observing, the circle was placed accurately over it. The signal was also adjusted to it, but it happened that when observing at the *Dúdhilí* station, the pyramidal frame having been blown down, I was compelled to take the angle on a tree close to which the signal had been placed. It is a well defined object, and its stem is short and straight. The distance of the station from it was determined to great nicety, by observing the angle between them from *Zephyr Hall*, distant only one mile.

This angle was,	0° 16′ 25″		
The angle at the north P. signal was,	96 45		
3d Angle,	82° 58′ 35″	Sine Ar. Co.	0 003 28
Log. distance of signals,	= 5485 Feet.		3 739 16
	Sine, 16′ 25″		7 679 01
Distance of centre of station, from centre of tree,	264 Feet.	=	1 421 45

Now at the centre of station, the angle between the tree, and the *Dúdhilí* signal was 137° 50′ the tree being to right of the latter. The distance of the signals is 53,064 feet. The reduction will then be;

Log. 53,064 Ar. Co.	5·2752
Sine, 137°·50	9·8269
Log. 26·4	1·4214
Sine, 1″ Ar. Co.	5·3145
Correction in seconds, 68″·9	1·8380 additive in *Azimuth.*

5th Station, Mitha Bérí.

Marked by a picket as usual. No reductions. It is about three furlongs S. E. of the village of that name, and not far off the road to *Déhra* from *Sahínspúr.*

6th Station, the Tank.

This station is on the road from *Sahínspúr* to *Déhra.* There is a tank surrounded by high banks, on the southern of which are several small white buildings erected, to commemorate *Satís* that have taken place. It is the eastern of these that marks the station. The place of observation is marked by a picket of the usual size. From *Nalapaní* the proper object was not visible, being hid by a tree, I was therefore obliged to intersect another of these buildings, the distance of which I carefully determined. A plan of the station, shewing the relative position of the three points is given plate 3, fig. 2.

The distance of the western *Satí,* from the picket as measured by a brass chain was found to be 68·1 feet, and of the eastern 7·3 feet.

The angle which the former made with *Nalapaní* was found to be 155° 15′, the latter being to the right. The eastern was to the right of *Nalapaní*, again 56° 12′. With these data, and the following distances we obtain the reductions.

Reductions to Centre, Distance 6·1 Feet, Longitude 90·7853.

Stations.	*Distance from centre of station.*	*Logarithm.*	*Angle between stations & centre.*	*Sines.*	*Reduction in Azimuth.*
	Feet.		° ′		Az. ″
Nalapaní,	53·720	4·7301	56 12 L.	9·9196	19·4 —
Dúdhilí station,	58·807	·7694	112 15 L.	9·9664	19·7 —
Bhadraj Dún,	58·689	·7685	128 56 L.	9·8909	16·7 —
Timli,	71·086	·8518	214 14 L.	9·7502	9·9 +
Mariruna. ⊙	82·316	·9155	82 47 L.	9·9965	15·2 —

THE reduction of the other *Satí* to the picket may be found thus:

Log. Ar. Co.	53·720	5·2699
Sine,	155·15	9·6219
Log.	169.	2·2279
		5·3144
	271″·7	2·4341

4′ 31″·7 add reduction to other *Satí*, 19″·4 sum is 4′ 51″·7. Which is the angle subtended by the two *Satís*, at *Nalapaní*.

7th Station, Northern Extremity of Base.

MARKED with a large picket as usual. It is on the edge of the *Rispanna Nala,* about 400 yards north of the village of *Dalanwala.* No reductions.

8th Station, Timli.

THIS station is about one mile or a little more S. W. of the village of that name, on a rising ground, a large picket as usual marks the spot. No reductions.

9th or Masírana Station.

THIS station is on a peak of the range which bounds the *Dún* to the north, shutting in the *Aglar*, one of the feeders of the *Jumna*. The point observed was a small pyramid of trees which had been formerly erected. From *Nalapaní*, however this point was not observed, but a pillar that had been built on the occasion of a former visit. The stand of the circle was placed exactly under the summit of the pyramid. The distance of the pillar observed at *Nalapaní* was 2.3 feet, and the angle which it formed with *Nalapaní* was 159°, the latter being to the left. This gives with the distance, 41·867 feet, the reduction is $= 4''\!\cdot\!1$—additive in *Azimuth.* (Plate 3. fig. 3).

10th Station, Surkanda.

THIS is one of the stations of the great triangulation, and it was for the determination of the distance of this and the *C'handpúr* station, that this triangulation was instituted. The point observed is the centre of a small *Math* or *Hindú* temple. The place of observation is a stone pillar, which is 14 feet from the centre of the building. The centre forms an angle with *Nalapaní* of 90°, being to the left, and consequently with the *Masírana* station an angle of 130°. With these and the distances, the

reductions to the centre are found to be 44″·7, for *Nalápaní* (in *Azimuth* +), and for the *Masírana* station 45″·9 (in *Azimuth* +). (Plate 3. fig. 4).

11*th Station, Bhadraj-Jounpúr.*

THIS station is on a mountain of *Jounpúr,* situated between the *Aglar* and the *Jumna,* a wooden temple with conical roof on the summit was the point observed, but the place of observation was on a stone pillar 9·5 feet from its centre. The angles which it formed with the different points intersected and their distances, as well as the reductions are given in the following table.

Reductions to Centre, Distance 9·5 Feet.

Stations.	*Distance from centre of station.*	*Logarithm.*	*Angle between stations & centre.*	*Sines.*	*Reduction in Azimuth.*
	Feet.		° ′		″
Masírana station, ...	43·966·4		51 30 L.		34·9 —
Bhadraj, ...	37·218		42 07 R.		35·3 +
Bairát fort, ...	38·946		103 22 R.		48·9 +
Bairát Math, ...	47·141		109 34 R.		39·2 +

12*th or Dúdhilí Station.*

THIS station is on a peak of the range to which *Bhadraj, Masírana* and *Surkanda* stations belong. The point observed was a pillar which had been previously erected, and it was on this that the circle was placed in observing. There are therefore no reductions.

13*th Station, Bhadraj.*

THIS station is on the eastern summit of a well known peak. The circle was placed on the pillar which was the point observed from the other stations, consequently there are no reductions. To distinguish it from the

station of the great triangulation which is on the western summit, I have called it the new station, and the other the old, their distance which will be useful was well determined from *Bairát*, and from *Bhadraj-Jounsar.*

14th Station, Bhadraj-Jounsar.

THIS station is on the ascent to *Bairát* fort from *Kalsí.* The place of observation is a pillar built in the centre of a platform of loose stones. The points intersected from other stations were the extrem corners of this platform. The plan (fig. 5) of the station will shew how the reductions are obtained.

THE corner observed at *Timlí* is the S. E. one; it is 9·6 feet from the pillar, from which place it forms an angle of 103° 38′. These data with the distance 90,456, gives the reduction at *Timli* 21″·4 + in *Azimuth.* From *Bhadraj*, two different corners were observed at different times. The first time the S. E. or middle one as it thence appeared. The angle which this forms with *Bhadraj* was found to be 29° 04′, which with the distance of *Bhadraj* 38,607, and that of the corner from the pillar 9·6 feet, gives the reduction at *Bhadraj* 25″·0 — in *Azimuth.* The second time the extreme corners were observed, which gives the place of the centre or middle point. Now from the diagram it may be seen that this point as viewed from *Bhadraj*, falls to right of the pillar ·6 feet, which at that distance subtends 3″·1 the reduction, in *Azimuth* it is —.

15th Station, Bairát Fort.

THIS is also one of the points of the great triangulation. The station is however different in the two triangulations, in the small one it is the south cor-

ner of the outer fort, in the large one, it is a pillar within the inner fort, the distance between these points has been determined accurately, being necessary for the solution of some of the great triangles. The figure (fig. 6) will shew the relative positions, and distances of the several points.

THE point observed was a flag staff at the corner of the bastion, but the circle could not be set up exactly in this point. It was placed on a pillar 9·1 feet from it, which formed an angle of 23° 25' with *Bhadraj*, the latter being to the right; with these data, and the distances, the following reductions may be calculated.

Reductions to Centre, Distance 7·6 Feet.

Stations.	*Distance from centre of stations.*	*Ar. Co. of Logarithm.*	*Angle between stations & centre.*	*Sines.*	*Reduction in Azimuth.*
	Feet.		° '		"
Bhadraj-Jounpúr,	38·946	5·4038	33 45 L.	9·7447	22·4 —
Bhadraj Dún new station,	38·829	·4108	23 25 R.	·5992	16·0 +
Bhadraj Dún old station,	88·380	·4159	25 26 R.	·6329	17·5 +
Timli,	107·576	4·9683	74 20 R.	·9835	14·0 +
Surkanda,	127·455	·8946	27 43 L.	·6675	05·7 —
Bhadraj-Jounsar,	19·131	5·7183	98 28 R.	·9052	80·9 +
C'handpúr,	98·212	5·0078	149 42 R.	·7029	08·1 +

16th Station, Bairát Math or Silgúr Stockade.

THE point observed was the centre of a small *Math* or temple about one mile from the fort, the following reductions are calculated.

Reductions to Centre.

Stations.	*Distance from centre of stations.*	*Ar. Co. of Logarithm.*	*Angle between stations & centre.*	*Sines.*	*Reduction in Azimuth.*
	Feet.		° '		"
Bhadraj-Jounpúr,	47·141	5·3266	177 38 R.	8·6159	1·4 +
Bhadraj Dún,	47·559	·3228	136 05 L.	9·8411	23·8 —
C'handpúr,	90·111	·0452	7	9·0859	02·2 —

17th Station, *C'handpúr Peak.*

THIS like *Bhadraj, Surkanda, Bairat,* is one of the stations of the great triangulation. It is a lofty mountain being elevated above *Sehàranpúr* 7548 feet. The object observed was the centre of a stone temple. The distance and the relative situation of this building, and the pillar on which the circle was placed, are shewn in the figure. With the data these contained, and the distances, the following reductions are calculated.

Reductions to Centre, Distance 44 Feet.

Stations.	Distance from centre of stations.	Ar. Co. of Logarithm.	Angle between stations & centre.	Sines.	Reduction in Azimuth.
	Feet.		° ′		″
Timli,	126·013	4·8996	159 00 L.	9·5543	25 8 —
Bhadraj Dún,	125·164	·9025	159 46 R.	·5389	25·7 +
Bairát,	98·212	5·0078	145 17 R.	·7555	52·6 +
Silgúr Stockade,	90·111	·0452	137 21 R.	·8309	68·2 +
Surkandá,	225·606	4·6467	146 45 R.	·7390	22·0 +

FROM every station but *Bairát* this point was observed, but from that place it could not be clearly seen, being in a great measure hid by another building, which is shewn in the plan, (fig. 7). The distance between their centre measured on a perpendicular to the direction of the *Bairát* station is 5·3 feet. This subtends at the distance of 98,212 feet an angle 10″·8, and this is the value of the reduction in *Azimuth.* It is + the true centre being to the right of the other as seen from *Bairát.*

Table of the Angles and Sides of the small Triangulation founded on the measured Base of 21,754·8 Feet.

		Names of Stations.	*Observed Angles.*	*Angles Reduced to Centre.*	*Angles for Calculation.*	*Logarithmic Sines.*	*Logarithms of Sides.*	*Sides in Feet.*	*Remarks.*
			° ′ ″		° ′ ″				
1	7	North extremity of base, ...	32 12 08·3		32 12 10	9 726 660	4 184 111	15 279·6	
	1	South extremity of base.	98 26 30·7		98 26 31	9 995 269	4 452 720	28 360·9	
	2	*Nawada*, ...	49 21 16·0		49 21 18	0 119 806	4 337 555	21 754·8	
			179 59 55·0						
			Error, 5·0						
2	7	North extremity of base, ...	106 29 12·9		106 29 13	9 981 766	4 429 850	26 906	
	1	South extremity of base, ...	22 40 51·0		22 40 51	9 586 134	4 034 218	10 819·8	
	3	*Zephyr Hall*, ...	50 49 56·8		50 49 57	0 110 529	4 337 555	21 754·8	
			180 00 00·7						
			Error, 10·7						
3	3	*Zephyr Hall*, ...	32 36 40·6		32 36 44	9 731 553	4 184 117	15 279·8	
	1	South extremity of base, ...	75 45 31·1		75 45 34	9 986 443	4 439 014	27 479·8	
	2	*Nawada*, ...	71 33 39·0		71 37 42	0 022 718	4 429 850	26 906 0	2
			179 59 50·7						
			Error, 9·3						
4	3	*Zephyr Hall*, ...	96 43 18·3		96 43 17	9 997 004	4 103 461	12 690 0	
	7	North extremity of base, ...	25 25 03·8		25 25 03	9 632 671	3 739 128	5 481·0	
	4	*Nalapani*, ...	57 51 40·6		57 51 40	0 072 230	4 034 218	10 819·8	12
			180 00 02·7						
			Error, 02·7						
5		With the sides 27 479·8 and 5484·0 being the distances of the 3d and 2d and of the 3d and 4th stations respectively, and the angle 179° 50′ 02″·9 being that subtended at the 3d station. By the other two, the distance of those stations (4th and 2d) is found to be 32 963·8 feet.							
6	7	North extremity of base, ...	99 42 03·3		99 42 01	9 993 746	4 518 050	32 964·8	
	2	*Nawada*.	22 18 05·0		22 18 03	9 579 177	4 103 481	12 690 6	
	4	*Nalapani*, ...	57 59 59·3		57 59 57	0 071 584	4 452 720	28 360 9	1
			180 00 07·6						
			Error, 07·6						

The distance of the 4th and 2d stations appears by this triangle to be 32 964·8 feet. By the preceding it has been found to be 32 963·8 feet. The mean of the two results is 32 964·3 with which the following triangle is resolved.

		Names of Stations.	Observed Angles.	Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides.	Sides in Feet.	Remarks.
			° ′ ″	° ′ ″	° ′ ″				
7	4	*Nalapani*,	58 08 49·0		58 08 38	9 929 100	4 577 479	37 798·9	
	2	*Newada*,	74 03 47·8		74 08 43	9 982 976	4 631 355	42 791·2	
	5	*Mitha Berí*,	47 47 13·2		47 47 39	0 130 336	4 518 013	32 964·3	5 and 6
8	5	*Mitha Berí*,	65 23 57·8	65 23 57·8	65 23 51	9 958 671	4 724 7[illegible]7	53 060·0	
	4	*Nalapani*,	67 26 31·9	67 26 31·9	67 26 26	9 965 430	4 731 526	53 892·2	
	12	*Dúdhili* station,	47 10 50·6	47 09 41·7	47 09 38	0 134 741	4 631 355	42 791·2	
				180 00 11·4					
				Error, 11·4					
9	12	*Dúdhili* station,	50 28 57·4	50 30 06·3	50 30 03	9 887 420	4 621 846	41 864·5	
	4	*Nalapani*,	51 32 09·1	51 32 13·2	51 32 15	9 893 770	4 629 106	42 181·1	
	9	*Masrana* station,	77 57 36·8	77 57 36·3	77 57 38	0 009 659	4 704 767	53 060·0	
				179 59 55·8					
				Error, 4·2					
10	9	*Masrana* station,	92 08 25·3	92 03 25·3	92 03 22	9 999 720	4 812 957	65 011·0	
	4	*Nalapani*,	47 53 21·8	47 53 17·7	47 53 14	9 870 302	4 683 569	48 258·0	
	10	*Surkanda*,	40 03 26·1	40 03 27·3	40 03 24	0 191 421	4 621 846	41 864·5	
				180 00 10·3					
				Error, 10·3					
11	4	*Nalapani*,	66 44 40·0	66 49 31·1	66 49 37	9 963 467	4 769 393	58 802·1	
	12	*Dúdhili* station,	57 08 17·8	57 07 08·9	57 07 15	9 924 185	4 730 111	53 7[illegible]6·9	
	6	Tank,	56 08 01·0	56 03 0[illegible]·4	56 03 08	0 081 159	4 724 767	53 060·0	
				179 59 41·4					
				Error, 18·6					
12	4	*Nalapani*,	56 59 04·1	57 08 55·2	57 04 02	9 923 922	4 768 115	58 693·4	
	6	Tank,	72 43 55·7	72 43 53·0	72 44 00	9 979 973	4 824 566	66 767·6	
	13	*Bhadraj Dún*,	50 11 51·3	50 11 51·3	50 11 58	0 114 482	4 730 111	53 716·9	
				179 59 39·5					
				Error, 20·5					

		Names of Stations.	Observed Angles.	Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Side.	Sides in Feet.	Remarks.
			° ′ ″	° ′ ″	° ′ ″				
	6	Tank,	85 18 45·1	85 18 21·5	85 18 15	9 998 546	4 946 410	88 391·4	
13	13	*Bhadraj-Dún,*	53 16 11·2	53 16 11·2	53 16 05	9 902 872	4 851 752	71 0[illegible]·7	
	8	*Timli,*	41 25 46·6	41 25 46·8	41 25 40	0 179 355	4 765 515	58 683·4	
				180 00 19·5					
				Error, 19·5					
	8	*Tirli,*	68 52 41·9	68 52 44·9	68 52 45	9 969 799	5 097 435	125 151·3	
14	13	*Bhadraj-Dún,*	69 54 35·9	69 54 35·9	69 54 36	9 972 786	5 100 372	126 [illegible]	
	17	*Chandpúr,*	41 15 30	41 12 3[illegible]·5	41 12 39	0 181 226	4 916 410	88 391·4	
				179 59 59·3					
				Error, 00·7					
	13	*Bhadraj-Dún,*	82 02 16·3	82 02 16·3	82 02 22	0 004 205	4 759 343	57 502·1	
15	6	Tank,	16 40 54·7	16 40 51·7	16 40 57	9 457 955	4 231 583	17 041·4	
							551	17 043·4	
	12	*Dúdhli* station,	81 16 35	81 16 35	81 16 41	0 005 051	4 765 515	58 385·4	
				179 59 43·0					
				Error, 17·0					
In this triangle there are two sides given which afford two results. The difference is 1·0 foot. The mean of the two values is 17,042·9									
	11	*Bhadraj-Jounpúr,*	93 37 33·8	93 38 44·0	93 38 42			37 214·3	
	13	*Bhadraj-Dún,*	53 59 31·2	53 59 31·2	53 59 29				
16	12	*Dúdhli* station,	171 06 19·0	171 06 12·0	171 06 11				
	9	*Masirana* station,	41 15 39·8	41 15 39·6	41 15 38			43 964·4	
				180 00 07·0					
				Error, 07·0					
The sides in feet are the distances of the station, on the line of which they are written from the next in order of writing. This quadrilateral is resolved by drawing parallels, through the 12th station to the opposite sides. From this operation two triangles result, the angles, and sides of which are as follows:									
	9	*Masirana* station,			41 15 38	9 819 204	4 448 280	28 072·4	
	12	*Dúdhli* station,			45 05 40	9 850 200	4 479 276		
		Intersection of the side 11·9,			93 38 42	0 000 880	4 628 196	30 140·2	
	3	*Bhadraj-Dún,*			53 59 29	9 907 010	4 140 357	13 815·2	
	12	*Dudhli* station,			32 21 49	9 728 580	3 961 036	9 141·9	
		Intersection of the side 13·11,			93 38 42	0 000 880	4 231 567		

From these, the two remaining sides of the quadrilateral as given above are easily deduced. Thus:

		28 072·4		13 815·2
		9 141·9		30 149·2
Distance of stations,	13·1	37 214·3	9·11	43 964·4

		Names of Stations.	Observed Angles.	Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides.	Sides in Feet.	Remarks.
			° ′ ″	° ′ ″	° ′ ″				
17	11	*Bhadraj-Jounpúr*,	93 37 33·8	93 38 44·0	93 38 47			37 218·6	
	13	*Bhadraj-Dún*,	85 49 52·2	85 49 52·2	85 49 55			66 767·6	
	4	*Nalapani*,	61 17 42·6	161 17 46·7	61 17 49			41 864·5	
	9	*Masirana* station,	119 13 26·0	119 13 26·0	119 13 29			43 958·1	

This quadrilateral is resolved by drawing parallells to the opposite sides through the 9th station, by which the two following triangles are obtained.

		Names of Stations.	Observed Angles.	Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides.	Sides in Feet.	Remarks.
	4	*Nalapani*,			161 17 49	9 913 059	4 566 055	36 817·6	The difference of this side & 13·4=66,767·6 is the datum of the following triangle.
	9	*Masirana* station,			32 52 11	9 734 600	4 357 596	22 782·2	
		Intersection of the side 4·13,			85 49 55	0 001 150	4 621 846	41 864·5	
	9	*Masirana* station,			0 31 18	7 959 264	2 603 453	401·0	
		Intersection of the line 13·11,			85 49 55	9 998 850	4 643 039	43 958·1	
	11	*Bhadraj-Jounpúr*,			93 33 47	0 000 880	4 643 309	43 955·4	

From these the unknown sides of the quadrilateral are concluded to be as above given.

		Names of Stations.	Observed Angles.	Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides.	Sides in Feet.	Remarks.
	6	Tank,	26 35 04·4	26 35 00·2					
3	4	*Nalapani*,	118 16 47·0	118 21 42·2					
	9	*Masirana* station,	35 03 06·2	35 03 06·2					
				179 59 48·6					
				Error, 11·4					

In this triangle there are given two sides and three angles, instead of correcting them for the difference of their sum from 180°. The distance of the stations 6·9 is found by using the two sides, and each of the three angles. This gives three results, 82 313·7 using the angle, 6
307·4 9
308·2 4

Mean. 82 309·8

		Names of Stations.	Observed Angles.	Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides.	Sides in Feet.	Remarks.
19	11	*Bhadraj-Jounpúr*,	93 37 33·8	93 33 44·0	93 33 47			37 218·7	
	13	*Bhadraj-Dún*,	136 01 48·7	136 01 48·7	136 01 52			56 653·4	
	6	Tank,	46 03 53·8	46 03 55·3	46 03 58			82 309·8	
	9	*Masirana* station,	84 10 19·8	84 10 19·8	84 10 23			43 962·7	
				179 59 47·8					
				Error, 12·2					

This quadrilateral is resolved by drawing parallels to the opposite sides through the 9th station, by which the 2 following triangles are obtained.

		Names of Stations.	Observed Angles.	Angles Reduced to Centre	Angles for Calculation.	Logarithmic Sines.	Logarithems of Sides.	Sides in Feet.	Remarks.
			° ′ ″	° ′ ″	° ′ ″				
	6	Tank,			46 08 58	9 858 025	4 652 955	44 973·5	
	13	*Bhadraj-Dun*,			49 40 39	9 882 191	4 628 794	42 539 3	
		Intersection of the side 13·4,			84 10 23	0 002 259	4 768 515	58 683·4	
	9	*Misirana* station,			2 10 50	8 580 340	4 570 761	37 218·7	
		Intersection of the line 13·11,			84 10 23	9 997 750	3 153 351	14 23·4	
	11	*Bhadraj-Jounpur*,			93 38 47	0 [illegible]	4 572 131	37 336 3	

The values of these two sides are then as follows:

By No.	16	37,214 3	43,964·4
	17	218·6	958·1
	19	218·7	962·7
Mean,		37.217 2	43.961·7

		Names of Stations.	Observed Angles.	Angles Reduced to Centre	Angles for Calculation.	Logarithmic Sines.	Logarithems of Sides.	Sides in Feet.	Remarks.
20	13	*Bhadraj-Dun*,	61 34 17 2	61 34 17 2	61 34 22	9 944 198	4 590 460	38 945·7	
	11	*Bhadraj-Jounpur*,	61 14 55·0	61 15 08·6	61 15 14	9 942 880	4 589 142	38 527·7	
	15	*Bairát* fort,	57 10 10·7	57 10 49·1	57 10 54	0 075 513	4 570 744	37 217·2	
				180 00 11·9					
				Error, 14·9					
21	11	*Bhadraj-Jounpur*,	67 26 57·5	67 27 01·4	67 26 56	9 965 455	4 673 392		
	13	*Bhadraj-Dun*,	66 16 14 8	66 16 14·8	66 16 10	9 961 634	4 677 213		
	16	*Bairát Math*,	46 17 23·7	46 16 58·5	46 16 54	0 141 011	4 570 744	37 217·2	
				180 00 14·7					
				Error, 14·7					
22	15	*Bairát* fort,	75 02 16·3	75 03 21·2	75 03 22	9 985 057	4 586 663	38 606 7	
	13	*Bhadraj-Dun*,	28 36 17·2	28 36 17 2	28 36 17	9 680 125	4 281 731	19 130·7	
	14	*Bhadraj-Jounsar*,	76 20 20	76 20 20	76 20 20	0 012 464	4 589 142	38 827·7	
				179 59 58·4					
				Error, 01·6					
23	15	*Bairát* fort,	132 12 26·9	132 14 10·2	132 14 11			38 945·7	
	11	*Bhadraj-Jounpur*,	61 14 55	61 15 08·6	61 15 10			37 217·2	
	13	*Bhadraj-Dun*,	90 10 20·4	90 10 17·3	90 10 18			38 608·1	
	14	*Bhadraj-Jounsar*,	76 20 20	76 20 20	76 20 21			19 129·3	
				359 59 56·1					
				Error, 03·9					

This quadrilateral is resolved by drawing parallels to the opposite sides through the 15th station, by which the 2 following triangles are obtained.

		Name of Stations.	Observed Angels.	Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of sides.	Sides in Feet.	Remarks.
			° ′ ″	° ′ ″	° ′ ″				
	11	*Bhadraj-Jounpúr*,			61 15 10	9 942 876	4 533 338	31 145·9	
	15	*Bairat* fort,			28 34 32	9 679 716	4 270 178	18 628·5	
		Intersection of the line 13·11,			90 10 18	0 000 002	4 590 460	38 945·7	
	15	*Bairát* fort,			13 29 21	9 367 843	3 619 555	4 462·2	
		Intersection of the side 13 14,			90 10 18	9 999 998	4 251 710	19 129·3	
	14	*Bhadráj-Jounsar*,			76 20 21	0 012 463	4 269 249	18 588·7	

From these the 2 remaining sides of the quadrilateral as given above are easily deduced. Thus,

4,462·2
31,145·9
38,608·1

		Name of Stations.	Observed Angels.	Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of sides.	Sides in Feet.	Remarks.
24	14	*Bhadraj-Jounsar*,	74 34 31·3	74 34 31·3	74 34 29			38 607·4	
	13	*Bhadraj-Dún*,	133 47 52·4	133 47 49·3	133 47 47			58 683·9	
	6	Tank,	85 18 48·1	85 18 21·5	85 18 19			71 054·1	
	8	*Timli*,	66 19 05·6	66 19 27·0	66 19 25			90 450·0	
				360 00 09·1					
				Error, 09·1					

This quadrilateral is resolved by drawing parallels to the opposite side through the 13th station, by which the 2 following triangles are obtained

		Name of Stations.	Observed Angels.	Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of sides.	Sides in Feet.	Remarks.
	13	*Bhadraj-Dún*,			28 22 16	9 676 838	4 458 548	30 146·9	
	6	Tank,			85 18 19	9 998 540	4 805 245	63 862·4	
		Intersection of the line 8 6,			66 19 25	0 038 186	4 768 519	58 683·9	
	14	*Bhadraj-Jounsar*,			74 34 29	9 984 067	4 609 924	40 687·2	
	13	*Bhadraj-Dún*,			39 06 06	9 799 822	4 424 679	26 587·6	
		Intersection of the side 8·14,			66 19 25	0 038 186	4 586 671	38 607·4	

From these the two remaining sides of the quadrilateral as given above are easily deduced. Thus,

40,687·2	26,587·6
30,146·9	63,862·4
71,034·1	90,450·0

		Name of Stations.	Observed Angels.	Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of sides.	Sides in Feet.	Remarks.
25	15	*Bairát* fort,	50 55 53·8	50 55 51·4	50 55 55·3			68 391·4	
	13	*Bhadraj-Dún*,	109 07 49·1	109 07 49·1	109 07 53·3			107 568·3	
	8	*Timli*,	19 56 07·5	19 56 07·5	19 56 11·4			38 827·7	

In this triangle there are two sides given, instead of correcting the angles for the difference of the sum from 180°. It is resolved as in the case of the 18th. Three results are obtained as follows:

Using the angle,	15	107,563·5
	8	575·3
	18	566·0
Mean,		107,568·3

		Names of Stations.	Observed Angles.	Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides.	Sides in Feet.	Remarks.
			° ′ ″	° ′ ″	° ′ ″				
26	14	Bhadraj-Jounsar,	150 54 51·3	150 54 51·3	150 54 55			107 570·7	
	15	Bairát fort,	24 06 18·7	24 07 25·6	24 07 29			90 450·0	[sults.
	8	Timli,	4 57 11·3	4 57 32·7	4 57 36			19 130·0	Mean of 22d & 23d re-

In this triangle there are two sides given, instead of correcting the angles for the difference of the sum from 180°. It is resolved as in the case of the 18th. Three results are obtained as follows:

Using the angle,	14	107,570·4
	8	8
	15	8
Mean,		107,570·7

		Names of Stations.	Observed Angles.	Angles Reduced to Centre.	Angles for Calculation.	Sums of Angles.	Cosines.	Logarithms of Sides.	Sides in Feet.	Logarithms of intercepted Sides.	Natural Numbers.
			° ′ ″	° ′ ″	° ′ ″						
27	8	Timli,	61 21 54·3	61 21 51·3	61 21 56	61 21 56	9 680 534	4 851 765	71 092·8	4 532 299	34 064·3
	6	Tank,	158 02 43·8	158 02 14·5	158 02 16	219 24 12	9 888 016	4 730 111	53 716·9	4 618 127	41 507·5
	4	Nalapani,	118 16 47	118 21 39·1	118 21 40	337 45 52	9 966 446	4 621 846	41 861·5	4 588 292	33 751·8
	9	Masirana station,	119 13 26	119 13 26	119 13 23	456 59 20	9 085 208	4 643 074	43 961·7	3 728 282	5 349·1
	11	Bhadraj-Jounpúr,	154 52 29	154 53 52·8	154 53 54	611 53 14	9 492 605	4 590 460	35 945·7	4 083 065	12 107·8
	15	Bairát fort,	108 06 08·1	108 06 44·5	108 06 46	720 00 00			107 564·9		107 564·9
				719 59 50·2							
				Error, 09·8							
							Sines				
28	15	Bairat fort,	75 22 22·7	75 22 22·6	75 22 24		9 985 692	5 100 428	126 017·0		
	8	Timli,	48 56 36	48 56 36	48 56 32		9 877 399	4 992 135	98 205·3		
	17	C'handpúr,	55 42 42·5	55 41 07·5	55 41 04		0 083 049	5 031 687	107 565·8		
				180 00 11·3							
				Error, 11·3							
							Cosines.				
29	4	Nalapaní,	109 11 04·4		109 11 04				107 412·3		
	13	Bhadraj-Dún,			34 51 53		9 914 090	4 812 957	65 011·0	4 738 656	54 784·3
	10	Surkanda,			35 57 03		9 903 230	4 824 566	66 767·6	4 721 217	52 628·0
											107 412·3

		Names of Stations.	Observed Angles.	Angles Reduced to Centre.	Angles for Calculation.	Sums of Angles.	Cosines.	Logarithms of Sides.	Sides in Feet.	Logarithms of intercepted Sides.	Natural Numbers.
			° ′ ″	° ′ ″	° ′ ″						
30	13	Bhadraj-Dún,			151 45 28				225 577·0		
	17	C'handpúr,			13 01 18		9 988 696	5 031 052	107 412·3	5 096 121	121 933
	10	Surkanda,			15 13 13		9 984 493	5 097 435	125 151·3	5 015 546	103 644
											225 577
31	15	Bairát fort,	6 03 22·5	6 03 39·2	6 03 39		9 997 566	4 590 459	38 945 7	4 538 025	38 728·0
	11	Bhadraj-Jaunpúr,	154 52 29	154 58 52·3	19 02 29		9 975 562	4 643 074	43 961·7	4 618 636	41 556·2
	9	Másiranú station,	148 43 19	148 43 18·6				4 683 569	48 258 0	4 673 590	47 161·8
	10	Surkanda,			12 14 13		9 990 021		127 446·0		127 446·0

The side 15·10 is easily calculated by remarking that the figure divides itself into 2 triangles in each of which one angle is common, and therefore that at 10. Subtended by stations 15·9 may be concluded to be 12° 14′ 13″ and that common to both triangles = 19° 02′ 29″.

		Names of Stations.	Observed Angles.	Angles Reduced to Centre.	Angles for Calculation.	Sums of Angles.	Cosines.	Logarithms of Sides.	Sides in Feet.	Logarithms of intercepted Sides.	Natural Numbers.
32	15	Bairát fort,	177 25 08·3	177 25 22·1	177 25 22·1				225 595		
	10	Surkanda,							98 205·3		
	17	C'handpúr,							127 446·0		

In a triangle so obtuse as this the base is equal to the sum of the sides.

$$-\frac{b\ a}{b+a}\ \text{V. S. (180 — Contained angle).}$$

Thus the correction in this case may be found as follows:

	° ′ ″		
V. S.	2 34 38	7 005·1	
Side,	15 17 98 205	4 992·1	
	10 15 127 446	5 105·3	
Sum of sides,	225 651	4 646·6	Ar. Co.
Correction,	— 56	1 749·1	
	225 595		

		Names of Stations.	Observed Angles.	Angles Reduced to Centre.	Angles for Calculation.	Sums of Angles.	Cosines.	Logarithms of Sides.	Sides in Feet.	Logarithms of intercepted Sides.	Natural Numbers.
33	8	Timlí,	18 28 30·5	18 28 30·5	18 28 30·5	18 28 31	9 977 019	4 851 762	71 082·4	4 828 781	67 418·8
	6	Tank,	158 02 43·8	158 02 14·5	158 02 14·5	176 30 45	9 999 195	4 730 111	53 716·9	4 729 306	53 617·4
	4	Nalapani,		166 14 59	166 14 59	342 45 44	9 980 041	4 812 987	65 011·0	4 793 028	62 090·9
	10	Surkanda,			17 14 16	360 00 00					183 127·1

		Names of Stations.	Observed Angles.	Angles Reduced to Centre.	Angles for Calculation.	Sums of Angles.	Cosines.	Logarithms of Sides.	Sides in Feet.	Logarithms of intercepted Sides.	Natural Numbers.
							Sines.				
34	17	C'handpúr,	91 50 00·8		54 13 43		0 090 789	5 268 752	183 127		
	8	Timli,			91 50 01		9 999 778	5 352 319	225 573		
	10	Surkanda,			33 56 16						

This triangle is resolved by calculating the angles at the base first, and then as usual by the proportionality of the sines of angles to the opposite sides.
This triangle affords the 3d value of the distance *C'handpúr-Surkanda*, the side from which the larger triangulation proceeds. They are

		Feet.
By the	30th	225·577
	32d	·595
	34th	·573
Mean,		225·582

The trianngles that follow are meant to fix the distances of some of the intermediate stations, required also in the solution of the great triangles.

		Names of Stations.	Observed Angles.	Angles Reduced to Centre.	Angles for Calculation.	Sums of Angles.	Cosines.	Logarithms of Sides.	Sides in Feet.	Logarithms of intercepted Sides.	Natural Numbers.
35	13	Bhadraj-Dún new station,	70 48 06·3	70 48 06·3	70 48 06		9 975 149	4 584 102	38 379 7		
	15	Bairát fort,	2 01 23·8	2 01 25·3	2 01 25		8 547 914	3 156 867	1 435·0		
	a.	Bhadraj-Dún old station,			107 10 29		0 019 811	4 589 142	38 827·7		

		Names of Stations.	Observed Angles.	Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides.	Sides in Feet.	Remarks.
36	13	Bhadraj-Dún new station,			176 39 36			107 412·3	
	a.	Bhadraj-Dún old station,						108 844·9	
	10	Surkanda,						1 435·0	

This triangle is resolved as the 32d thus:

		° ′ ″		
	V. S.	3 20 24	Log.	7 231 89
Side,	13 10	107 412·3	Log.	5 031 05
	13 a.	1 435·0	Log.	3 156 87
Sum of Sides,		108 847·3	Ar.Co.	4 963 18
				0 382 99
Correction,		— 2·4		
		108 844·9		

		Names of Stations.	Observed Angles.	Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides.	Sides in Feet.	Remarks.
37	8	Timli,	63 05 00	63 05 00	63 05 00	9 950 202	5 231 315	170 339·4	
	15	Bairát fort,		82 33 50	82 38 50	9 996 414	5 277 527	189 464·0	
	b.	Chúr,			34 16 10	0 249 426	5 031 657	107 568·8	

		Names of Stations.	Observed Angles.	Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides.	Sides in Feet.	Remarks.
38	b.	Chúr,	*	175 17 59				127 446·0	
	15	Bairat fort,						297 540·0	
	10	Surkanda,						170 339·4	

This triangle is resolved as the 32d and 36.

	V. S. 4 42 01	Log.	7 526 728
Side,	15 b. 170 339·4	Log.	5 231 315
	15 10 127 446·0	Log.	5 105 326
Sum of sides,	297 735	Ar.Co.	4 526 097
Correction,	— 245·2		2 389 466
Side,	b. 10 297 540		

		Names of Stations.	Observed Angles.	Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides.	Sides in Feet.	Remarks.
39	13	Bhadraj-Dún, new station,	31 34 49·3	31 34 49	31 24 49			123 931·0	
	b.	Bhadraj-Dún old station,						125 151·3	
	17	C'handpúr,						1 435·0	

This triangle is resolved as follows:

From the vertex b. let fall a perpendicular on the known sides 13.17 meeting it in x.

Then side, 17 b. = 1 435·0 — 3 156 867 — Also 17 b. — 3 156 867

× Cos ∠ 13 31° 34′ 49″ — 9 930 392 — × Sine 31° 34′ 49″ — 9 719 076

is equal to 13 x = 1222·5 — 3 087 259 — = b. x. — 2 875 943 = Tang. to

Subtract it from 13 17 125 151·3

Remains, 17 x = 123 928·8 — 5 093 144 = Rad,

The tangent of 20′ 51″ is 7 782 799

Its L. Cosine is 9 999 992

Subtracted from L. Side, 17 x 123,928·8 — 5 093 144

= 17 b 123.931·0 — 5 093 152

End of the small triangulation.

* The third angle in this triangle was not observed, but the distance concluded is checked by another triangle in the large series.

Table of the Angles and Sides of the Great Triangulation.

No.	Names of Stations.	Observed Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of sides opposite.	Sides in Feet.	Remarks.
		° ′ ″	° ′ ″				
	Chandpúr Math, ...	68 56 07	68 56 23	9 969 976	5 456 597	286 152	
1	Surkanda pyramid, ...	63 41 38	63 41 46	9 952 529	5 439 150	274 885	Mean of 3 results : small triangulation.
	Belville pillar, ...	47 21 42	47 21 50	0 133 317	5 353 304	225 582	
		179 59 27					
	Shd. be	180 00 14					
		Error, 47					
	Bairát inner pillar, ...	88 43 39	88 43 29	9 999 892	5 456 698	286 219	The distance of *Bairát* flag staff from *Surkanda* is by the small triangulation 127,446. By the plan of the station, given with the appendix, it may be seen that the pillar is 46 feet more.
2	Surkanda, ...	64 50 01	64 49 51	9 956 675	5 413 481	259 108	
	Belville, ...	26 26 49	26 26 39	0 351 323	5 105 483	127 492	
		180 00 29					
	Shd. be	180 00 08					
		Error, 21					
	Chúr pyramid, ...	52 35 46	52 35 30	0 100 000	5 413 481	259 108	
3	Bairát.	95 56 30	95 56 14	9 997 664	5 511 145	324 448	
	Belville, ...	31 28 31	31 28 15	9 717 724	5 231 205	170 297	The small triangulation gives 170,339·4 for the flag staff. This is for the pillar 170,286.
		180 00 47					
	Chúr, ...	42 54 45	42 54 35			73 960	The distances are those of the station opposite which they are written from, the following one, and in the case of the last of it, from the first.
	Chandpúr, ...	195 29 16	195 29 06			225 582	
4	Surkanda, ...	63 41 38	63 41 28			286 186	
	Belville, ...	57 55 21	57 55 11			324 398	
		360 01 00					
	Shd. be	360 00 18					

No.	Names of Stations.	Observed Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of sides opposite.	Sides in Feet.	Remarks.
5	Bhadraj-Dun old station,	110 44 31	110 44 21	9 970 907	5 456 703	286 222	By the small triangulation.
	Sarkanda,	48 25 51	48 25 41	9 873 573	5 359 769	228 965	
	Belville,	20 50 08	20 48 58	0 448 987	5 036 809	108 845	
		180 00 30					
6	Chár,	44 14 17	44 14 04	0 156 396	5 359 769	228 965	The 3 values of this distance are 324 458, 448, 398; Mean, 324 435
	Bhadraj.	98 41 09	98 40 56	9 994 994	5 511 159	324 458	
	Belville,	37 05 13	37 05 00	9 780 300	5 296 465	197 909	
		180 00 39					
7	Chár,		54 35 09			286 198	With the observed angle and the given sides, the other angles are calculated
	Belville.	57 55 21	57 55 15	9 928 045	5 473 577	297 562	
	Sarkanda.		67 29 38	0 034 401	5 511 128	324 435	
8	Chár,					225 582	
	Chandpúr,	164 30 41	164 30 44			297 509	
	Sárkanda,					73 960	
9	Jytee,	73 55 43	73 55 46	0 017 312	5 296 465	197 909	
	Chár.	75 41 41	75 41 44	9 986 322	5 300 099	199 572	
	Bhadraj,	30 22 27	30 22 30	9 703 856	5 017 633	104 144	
		179 59 51					
10	Belville.	50 04 52	50 04 49	9 884 734	5 300 090	199 568	
	Bhadraj.	68 17 17	68 17 14	9 968 039	5 383 365	241 749	
	Jytee,		61 37 58	0 005 557	5 359 769	228 965	
11	Belville,	70 54 58	70 54 48	9 975 443	5 489 126	308 408	
	Sarkanda,	47 48 33	47 48 28	9 869 757	5 383 440	241 791	
	Jytee,		60 16 44	0 057 016	5 456 667	286 198	

No.	Names of Stations.	Observed Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides opposite.	Sides in Feet.	Remarks.
	Kedar Kanta,		64 01 11	0 046 267	5 353 304	225 582	
12	*Surkanda,*	52 06 04	52 06 01	9 897 125	5 296 696	198 014	
	Chandpúr,	63 52 51	63 52 48	9 953 215	5 352 786	225 313	
•	*Kedar Kanta,*	48 39 50	48 39 48	0 124 452	5 231 192	170 291	Mean of the 3d, and of the result of the small triangulation.
13	*Chúr,*		50 43 31	9 888 808	5 244 452	175 571	
	Bairát,	80 36 44	80 36 42	9 994 143	5 349 787	223 763	
	Kedar Kanta,		34 18 40	0 248 963	5 105 483	127 492	
14	*Bairat,*	94 43 06	94 43 05	9 998 526	5 352 972	225 410	
	Surkanda,	50 58 16	50 58 15	9 890 323	5 244 769	175 699	
	Uchalarí,	32 12 01	32 11 38	0 273 447	5 105 483	127 492	
15	*Surkanda,*	88 59 20	88 58 51	9 999 931	5 378 861	239 256	
	Bairat,	58 49 54	58 19 28	9 952 263	5 311 193	204 735	
		180 01 18					
	Chúr,	97 42 09	97 42 00	9 996 066	5 703 321	505 035	
16	*B[illegible]ville,*	42 45 46	42 45 37	9 831 827	5 539 082	346 005	
	Black E.			0 196 127	5 511 128	324 435	
	Surkanda,	79 11 17	79 11 12	9 999 291	5 539 058	345 986	
17	*Chúr*	43 06 39	43 06 31	9 834 671	5 381 438	240 679	
	Black E.		57 39 15	0 073 229	5 473 538	297 535	
	Chúr	53 26 40	53 26 36	9 904 860	5 443 845	277 872	The several values of this distance are 34[illegible] 783, 345 986, 346 005, 345 751 } Mean, 345 881
18	*Bhadráj*	91 39 38	91 39 34	9 999 818	5 538 803	345 783	
	Black E.		34 53 51	0 242 520	5 296 465	197 909	
	Chúr	45 05 39		9 850 187	5 407 827	255 757	
19	*Bairat*	106 46 18		9 981 124	5 538 764	345 751	
	Black E.		28 08 12	0 326 448	5 231 192	170 291	

No.	Names of Stations.	Observed Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides opposite.	Sides in Feet.	Remarks.
	Chúr,	96 29 02	96 28 53	9 997 215	5 694 756	495 172	
20	*Belville*,	42 54 11	42 54 02	9 832 974	5 530 515	339 246	
	Great E.,		40 37 04	0 186 413	5 511 128	324 435	
	Chúr,	41 53 46	41 53 41	9 824 623	5 363 319	230 844	
21	*Surkanda*,	78 42 49	78 42 44	9 991 518	5 530 214	339 011	
	Great E. or *Benderpooch*,		59 23 35	0 065 158	5 473 538	297 535	
	Bairát,	107 28 29	107 28 26	9 979 482	5 530 016	338 856	The 3 values of this distance are 338 856, 339 211, 339 246 } Mean, 339 104
22	*Chúr*,		43 52 57	9 840 847	5 391 381	246 253	
	Great E. or *Benderpooch*,		28 38 37	0 319 312	5 231 192	170 291	
	Uchalarú,	96 07 52	96 07 51	9 997 509	5 391 734	246 453	
23	*Bairát*,	9 01 12	9 01 11	9 195 275	4 589 500	38 860	
	Great E. or *Benderpooch*,		74 50 57	0 015 364	5 378 861	239 256	
	Uchalarú,	128 20 06	128 20 06	9 894 536	5 363 587	230 987	
24	*Surkanda*,	7 37 04	7 37 04	9 122 425	4 591 476	390 370	
	Great E. or *Benderpooch*,		44 02 50	0 157 858	5 311 193	204 735	
	Belville,		42 01 23	9 825 705	5 519 621	330 842	
25	*Chúr*,		96 56 47	9 996 799	5 690 715	490 586	
	Low E.,		41 01 51	0 182 788	5 511 128	324 435	
	Chúr,	42 21 39	42 21 34	9 828 518	5 360 078	229 128	
26	*Surkanda*,	76 36 15	76 36 10	9 988 018	5 519 578	330 810	
	Low E.,		61 02 16	0 058 022	5 473 538	297 535	
	Bairát,	105 58 39	105 58 34	9 982 893	5 519 395	330 670	The 3 values of this distance are 330 842, 810, 670 } Mean, 330 774
27	*Chúr*,	44 20 53	44 20 50	9 844 480	5 380 982	240 426	
	Low E.,		29 40 34	0 305 310	5 231 192	170 291	

No.	Names of Stations.	Observed Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides opposite.	Sides in Feet.	Remarks.
		° ′ ″	° ′ ″				
28	Chúr′,	65 52 25	65 52 20	9 960 298	5 517 680	329 367	
	Bhadraj,	80 52 22	80 52 17	9 994 464	5 551 846	356 325	
	The Cone or S. No. 35,		33 15 22	0 260 917	5 296 465	197 909	
29	Chúr′,	57 31 24	57 31 21	9 926 138	5 479 032	301 323	
	Bairát,	94 00 18	94 00 15	9 998 938	5 551 832	356 313	
	The Cone (S) No. 35,		28 28 24	0 321 702	5 231 192	170 291	
30	Chúr′,	110 07 54	110 07 46	9 972 627	5 747 067	558 557	The three values of this distance are 356 325, 313, 522 } Mean, 356 387
	Belville,	36 49 20	36 49 12	9 777 646	5 552 086	356 522	
	The Cone (S) No. 35,		33 03 02	0 263 312	5 511 128	324 435	
31	Chúr′,	115 32 50	115 32 43	9 955 324	5 737 166	545 968	
	Belville,	32 02 07	32 02 00	9 724 624	5 506 466	320 971	
	L. No. 40,		32 25 19	0 270 714	5 511 128	324 435	
32	Chúr′,	60 57 44	60 57 37	9 941 652	5 497 368	314 817	
	Surkanda,	63 11 17	63 11 10	9 950 597	5 506 313	320 858	
	L. No. 40,		55 51 12	0 082 178	5 473 538	297 535	
33	Chúr′,	62 57 02	62 56 58	9 949 685	5 457 636	286 837	The three values of this distance are 320 971, 858, 908 } Mean, 320 912
	Bairát,	85 07 53	85 07 49	9 998 430	5 506 381	320 908	
	L. No. 40,		31 55 13	0 276 759	5 231 192	170 291	
34	Chandpúr,	70 27 05	70 27 00	9 974 213	5 497 365	314 315	
	Surkanda,	66 59 42	66 59 37	9 964 006	5 487 158	307 014	
	L. No. 40,		42 33 24	0 169 848	5 353 304	225 582	
35	Chúr′,	77 09 19	77 09 15	9 988 992	5 536 459	343 921	
	Black E.,		24 10 14	9 612 205	5 159 672	144 435	
	Whartú fort,	78 40 34	78 40 30	0 008 540	5 538 927	345 881	

No.	Names of Stations.	Observed Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides opposite.	Sides in Feet.	Remarks.
		° ′ ″	° ′ ″				
36	*Chúr*,	78 24 10	78 24 06	9 991 040	5 532 519	340 815	
	Great E.,		24 31 24	9 618 115	5 159 594	144 409	
	Whartú fort,	77 04 33	77 04 29	0 011 146	5 530 333	339 104	
37	*Chúr*,	77 56 16	77 56 13	9 990 302	5 521 257	332 091	
	Low E.,		25 08 50	9 628 353	5 159 288	144 304	
	Whartú fort,	76 55 00	76 54 57	0 011 424	5 519 531	530 774	
38	*Chúr*,	64 43 39	64 43 35	9 956 302	5 508 349	322 366	
	The Cone,		23 54 05	9 607 630	5 159 677	144 437	
	Whartú fort,	91 22 24	91 22 20	0 000 125	5 551 922	356 387	
39	L.,		21 41 56	9 652 538	5 159 982	144 538	The several values of this distance are 144 435, 409, 304, 437, 538; Mean, 144 425
	Chúr,	59 18 14	59 18 11	9 934 437	5 441 881	276 618	
	Whartú fort,	93 59 56	93 59 53	0 001 058	5 506 386	320 912	
40	*Chúr*,	127 03 07	127 03 00	9 902 063	5 789 780	616 283	
	Belville,	28 06 28	28 06 21	9 673 115	5 560 832	363 774	
	No. 50 *Raldeng*,		24 50 40	0 376 589	5 511 128	324 435	
41	*Chúr*,	74 26 48	74 26 43	9 983 795	5 553 367	357 575	
	Bairát,	78 14 47	78 14 42	9 990 795	5 560 367	363 385	
	No. 50 *Raldeng*,		27 18 34	0 338 380	5 231 192	170 291	
42	*Surkanda*,	62 59 56	62 59 51	9 949 871	5 488 070	307 659	
	Chandpúr,	76 12 51	76 12 46	9 987 303	5 525 502	335 353	
	No. 46,		40 47 24	0 184 895	5 353 304	225 582	
43	*Belville*,	27 23 08	27 22 59	9 662 698	5 409 706	256 866	
	Whartú,	95 36 16	95 36 07	9 997 921	5 744 929	555 813	
	No. 46,		57 00 55	0 076 334	5 670 674	468 462	

No.	Names of Stations.	Observed Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides opposite.	Sides in Feet.	Remarks.
		° ′ ″	° ′ ″				
	Belville, ...	28 55 43	28 55 37	9 684 571	5 525 187	335 110	
44	Surkanda, ...	126 40 22	126 40 16	9 904 216	5 744 832	555 690	
	No. 46, ...		24 23 58	0 383 949	5 456 667	286 198	
	Chandpúr, ...	67 52 50	67 52 45	9 966 795	5 482 860	303 990	
45	Surkanda, ...	68 41 38	68 41 33	9 969 250	5 485 315	305 714	
	a No. 1, (No. 39),......		43 25 42	0 162 761	5 353 304	225 582	
	Bairát, ...	87 40 04	87 40 01	9 999 640	5 482 810	303 955	
46	Surkanda, ...	67 33 23	67 33 20	9 965 789	5 448 959	281 164	
	a No. 1, (No. 39), ...		24 46 39	0 377 687	5 105 483	127 492	
	Bairát, ...	87 26 32	87 26 29	9 999 567	5 483 152	304 195	
47	Surkanda,...............	67 48 26	67 48 23	9 966 570	5 450 155	281 939	
	a No. 2,................		24 45 08	0 378 102	5 105 483	127 492	
48	Chandpúr, ...	118 49 26	118 49 21	9 942 562	5 695 539	496 055	
	Surkanda, ...	37 42 01	37 41 56	9 786 405	5 539 382	346 244	
	Kot-Gurh peak, ...		23 28 43	0 399 673	5 353 304	225 582	
	Chandpúr, ...	54 56 31	54 56 26	9 913 049	5 452 770	283 642	
49	Kedar Kanta,...........	90 12 34	90 12 29	9 999 987	5 539 718	346 512	
	Kot-Gerh peak, ...		34 51 04	0 243 015	5 296 696	198 014	
	Chúr,....................	88 44 26	88 44 20	9 994 929	5 580 266	380 423	
50	Surkanda,...............	40 38 07	40 38 01	9 813 742	5 399 079	250 656	
	Pyramidal peak hither range,		50 37 39	0 111 799	5 473 538	297 535	
	Chúr,....................	31 31 37	31 31 35	9 718 411	5 170 781	148 177	
51	Whartú, ...	117 50 00	117 49 58	9 946 606	5 398 976	250 597	
	Pyramidal peak hither range,		30 38 26	0 292 728	5 159 642	144 425	
	Chúr,....................	90 30 04	90 29 58	9 999 983	5 592 938	391 686	
52	Surkanda,...............	40 04 25	40 04 19	9 808 717	5 401 672	252 158	
	Peak a, hither range,.......		49 25 43	0 119 417	5 473 538	297 535	

No.	Names of Stations.	Observed Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides opposite.	Sides in Feet.	Remarks.
		° ′ ″	° ′ ″				
53	*Whartú*,	120 43 55	120 43 54	9 934 281	5 401 554	252 089	
	Chúr,	29 46 00	29 45 59	9 695 888	5 163 161	145 600	
	Peak *a*, hither range,		29 30 08	0 307 631	5 159 642	144 425	
54	*Bairát*,	76 28 52	76 28 49	9 987 79[illegible]	5 414 778	259 883	
	Surkanda,	75 01 55	75 01 52	9 985 00[illegible]	5 411 989	258 220	
	H. left peak,		28 29 18	0 321 4[illegible]	5 105 483	127 492	
55	*Bairát*,	98 51 10	98 51 07	9 994 796	5 54[illegible]	[illegible]	
	Chúr,	50 32 10	50 32 07	9 887 626	5 411 898	258 165	
	H. left peak,		30 36 47	0 293 080	5 231 192	170 291	
56	*Chúr*,	103 07 57	103 07 49	9 988 495	5 710 154	513 044	
	Belville,	38 51 33	38 51 25	9 797 529	5 519 188	330 512	
	H. left peak,		38 00 47	0 210 531	5 511 128	324 435	
57	*Surkanda*,	75 28 51	75 28 48	9 985 902	5 413 198	258 940	
	Bairát,	76 03 17	76 03 14	9 987 006	5 414 302	259 598	
	H. middle peak,		28 27 57	0 321 813	5 105 483	127 492	
58	*Bairát*,	99 16 38	99 16 35	9 994 283	5 521 479	332 261	
	Chúr,	50 20 23	50 20 20	9 886 391	5 413 587	259 171	
	H. middle peak,		30 23 06	0 296 004	5 231 192	170 291	
59	*Chúr*,	102 56 10	102 56 02	9 988 839	5 710 757	513 756	
	Belville,	39 04 56	39 04 48	9 799 620	5 521 538	332 306	
	H. middle peak,		37 59 11	0 210 790	5 511 128	324 435	
60	*Bairát*,	75 45 27	75 45 24	9 986 440	5 416 216	260 745	
	Surkanda,	75 57 17	75 57 14	9 986 817	5 416 593	260 971	
	H. right peak,		28 17 21	0 324 293	5 105 483	127 492	
61	*Bairát*,	99 34 28	99 34 25	9 993 909	5 524 337	334 455	
	Chúr,	50 17 23	50 17 20	9 886 082	5 416 500	260 911	
	H. right peak,		30 08 16	0 299 226	5 231 192	170 291	

No.	Names of Stations.	Observed Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides opposite.	Sides in Feet.	Remarks.
		° ′ ″	° ′ ″				
	Chúr,	102 53 10	102 53 02	9 988 926	5 712 112	515 361	
62	Belville,	39 15 45	39 15 37	9 801 297	5 524 483	334 567	
	H. right peak.		37 51 22	0 212 058	5 511 128	324 435	
	Chúr,	87 17 13	87 17 02	9 999 512	5 720 832	525 814	
63	Belville,	54 40 16	54 40 05	9 911 592	5 632 912	429 450	
	C.		38 02 53	0 210 192	5 511 128	324 435	
	Chúr,	32 41 51	32 41 47	9 732 544	5 381 180	240 536	
64	Surkanda,	105 22 37	105 22 33	9 984 170	5 632 806	429 345	
	C.		41 55 40	0 175 098	5 473 538	297 535	
	Uchalárá,	106 07 10	106 07 09	9 982 582	5 381 292	240 598	
65	Surkanda,	19 02 48	19 02 49	9 513 678	4 912 388	81 731	
	C.		54 50 04	0 087 517	5 311 193	204 735	
	Chúr,	92 25 25	92 25 14	9 999 612	5 730 412	537 541	
66	Belville,	50 29 46	50 29 35	9 887 363	5 618 163	415 110	
	G.		37 05 10	0 219 672	5 511 128	324 435	
	Chúr,	37 50 03	37 49 57	9 787 712	5 408 875	256 375	
67	Surkanda,	96 47 07	96 47 01	9 996 949	5 618 11[illegible]	415 06[illegible]	
	G.		45 23 02	0 147 625	5 473 538	297 535	
	Uchalárá,	135 34 06	135 34 05	9 845 13	5 409 033	256 468	
68	Surkanda,	10 27 20	10 27 19	9 258 800	4 822 697	66 481	
	G.		33 58 35	0 252 704	5 311 193	204 735	
	Chúr,	90 24 05	90 23 54	9 999 989	5 730 876	538 116	
69	Belville,	52 31 38	52 31 27	9 899 607	5 630 494	427 065	
	F.		37 04 39	0 219 759	5 511 128	324 435	
	Chúr,	35 48 43	35 48 37	9 767 232	5 405 759	254 542	
70	Surkanda,	101 02 24	101 02 18	9 991 890	5 630 417	426 990	
	F.		43 09 05	0 164 989	5 473 538	297 535	

No.	Names of Stations.	Observed Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides opposite.	Sides in Feet.	Remarks.
		° ′ ″	° ′ ″				
	Uchalárú,	122 38 09	122 38 08	9 925 373	5 405 542	254 414	
71	*Surkanda,*	14 42 08	14 42 07	9 404 475	4 884 644	76 673	
	F.		42 39 45	0 168 976	5 311 193	204 735	
	Chúr,	84 52 01	84 51 48	9 998 25[illegible]	5 753 981	567 520	
72	*Belville,*	60 26 0[illegible]	60 25 48	9 939 39[illegible]	5 695 125	495 594	
	D.		34 42 24	0 244 6[illegible]	5 511 128	324 435	
	Bairát,	130 51 23	130 51 17	9 878 735	5 7[illegible]	[illegible]	
73	*Belville,*	28 57 30	28 57 24	9 684 978	5 560 515	363 509	
	D.		20 11 18	0 462 056	5 413 481	259 108	
	Bairát,	46 37 46	46 37 44	9 861 487	5 440 803	275 933	
74	*Surkanda,*	113 44 48	113 44 46	9 961 582	5 540 898	347 455	
	M.		19 37 31	0 473 833	5 105 483	127 492	
	Bairát,	135 21 04	135 20 59	9 846 818	5 749 982	562 318	
75	*Belville,*	25 45 25	25 45 20	9 638 022	5 541 186	347 685	
	M.		18 53 41	0 489 683	5 413 481	259 108	
	Bairát,	102 25 31	102 25 24	9 989 714	5 688 425	488 006	
76	*Whartú,*	44 03 58	44 03 51	9 842 274	5 540 985	347 524	
	M.		33 30 46	0 257 964	5 440 747	275 897	
	Kedar Kanta,	72 59 58	72 59 53	9 980 592	5 483 464	301 414	
77	*Surkanda,*	61 52 42	61 52 37	9 945 438	5 418 310	280 744	
	The pyramid,		45 07 31	0 149 568	5 353 304	225 582	
	Belville,	26 40 46	26 40 37	9 652 207	5 418 781	281 050	
78	*Kedar Kanta,*	109 21 52	109 21 43	9 974 716	5 771 293	590 600	
	The pyramid,		43 57 40	0 158 534	5 638 043	434 553	
	Chúr,	82 58 08	82 57 54	9 996 718	5 789 201	615 462	
79	*Belville,*	65 29 38	65 29 24	9 958 988	5 751 471	564 250	
	B. middle peak,		31 32 43	0 281 355	5 511 128	324 435	

No.	Names of Stations.	Observed Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides opposite.	Sides in Feet.	Remarks.
		° ′ ″	° ′ ″				
	Chúr,	28 23 00	28 22 54	9 677 007	5 523 835	331 068	
80	Surkanda,	126 34 24	126 34 18	9 904 776	5 751 604	564 422	
	B. middle peak,		25 02 49	0 373 290	5 473 538	297 535	
	Chúr,	82 24 01	82 23 47	9 996 164	5 785 858	610 743	
81	Belville,	65 50 09	65 49 54	9 960 160	5 749 851	562 153	
	B. right peak,		31 46 20	0 278 566	5 511 128	324 435	
	Chúr,	27 48 52	27 48 46	9 668 930	5 517 863	329 506	
82	Surkanda,	127 16 18	127 16 12	9 900 79[illegible]	5 719 732	561 994	
	B. right peak,		24 55 03	0 375 395	5 473 538	297 535	
	Chúr,	23 26 18	23 26 11	9 599 638	5 699 122	500 175	
83	Surkanda,	142 52 32	142 52 25	9 780 731	5 880 215	758 954	
	A. No. 3. or P.		13 41 14	0 625 946	5 473 538	297 535	
	Chúr,	33 47 24	33 47 18	9 745 173	5 781 201	604 228	
84	Bhadraj,	135 43 05	135 42 59	9 843 986	5 880 114	758 777	
	A. No. 3. or P.		10 29 34	0 739 663	5 296 465	197 909	
	Chúr,	74 49 37	74 49 18	9 984 579	5 891 821	779 509	
85	Belville,	81 32 01	81 31 42	9 995 235	5 90[illegible]	[illegible]	
	A. No. 2,		23 41 01	0 396 114	5 511 128	324 435	
	Belville,	23 36 32	23 36 20	9 602 535	5 723 770	529 384	
86	Surkanda,	143 53 41	143 53 29	9 770 347	5 891 582	779 080	
	A. No. 2,		12 30 10	0 664 568	5 456 667	286 198	
	Bhadraj,	118 15 51	118 15 44	9 944 876	5 854 603	715 489	
87	Belville,	45 22 15	45 22 05	9 852 257	5 762 004	578 101	
	A. No. 1.		16 22 15	0 549 978	5 359 769	228 965	
	Bairát,	108 59 33	108 59 20	9 975 699	5 854 902	715 985	
88	Belville,	50 58 57	50 58 44	9 890 373	5 769 576	588 269	
	A. No. 1.		20 01 56	0 465 722	5 413 481	259 108	

No.	Names of Stations.	Observed Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides opposite.	Sides in Feet.	Remarks.
		° ′ ″	° ′ ″				
89	Kedar Kanta,	53 09 16	53 09 13	9 903 223	5 309 839	204 098	
	Surkanda,	64 39 35	64 39 32	9 956 061	5 362 677	230 503	
	J.		62 11 16	0 053 312	5 353 304	225 582	
90	Uchalárú,	76 03 49	76 03 48	9 987 02[illegible]	5 308 954	203 683	
	Surkanda,	26 37 30	26 37 29	9 651 41[illegible]	4 973 348	94 048	
	J.		77 18 44	0 010 7[illegible]7	5 311 193	204 735	
91	Uchalárú,	95 11 14	93 11 13	9 999 328	[illegible]	[illegible]	
	Surkanda,	22 57 50	22 57 49	9 591 227	4 949 318	88 985	
	Q. No. 8, right peak,		63 50 58	0 046 898	5 311 193	204 735	
92	Uchalárú,	113 30 20	113 30 19	9 962 380	5 399 020	250 622	
	Surkanda,	17 58 50	17 58 49	9 489 522	4 926 162	84 365	
	C. 1,		48 30 52	0 125 447	5 311 193	204 735	
93	Uchalárú,	96 31 06	96 31 05	9 097 184	5 359 891	229 029	
	Surkanda,	20 50 26	20 50 25	9 551 162	4 913 869	82 010	
	C. 2,		62 38 30	0 051 511	5 311 193	204 735	
94	Kedar Kanta,	64 53 36	64 53 32	9 956 894	5 381 125	240 506	
	Surkanda,	57 04 51	57 04 47	9 923 983	5 348 214	222 954	
	C.		58 01 42	0 071 445	5 352 786	225 313	
95	Kedar Kanta,	77 20 53	77 20 51	9 989 324	5 363 346	230 859	
	Surkanda,	30 25 32	30 25 30	9 704 502	5 078 524	119 819	
	Great E. or Benderpooch,		72 13 40	0 021 236	5 352 786	225 313	
96	Kedar Kanda,	81 21 08	81 21 06	9 995 034	5 381 582	240 759	
	Surkanda,	30 56 59	30 56 57	9 711 197	5 097 745	125 240	
	Black E.		67 41 58	0 033 762	5 352 786	225 313	
97	Kedar Kanta,	77 46 43	77 46 41	9 990 043	5 360 191	229 188	
	Surkanda,	28 18 58	28 18 56	9 676 078	5 046 226	111 231	
	Low E.		73 54 24	0 017 362	5 352 786	225 313	

No.	Names of Stations.	Observed Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides opposite.	Sides in Feet.	Remarks.
		° ′ ″	° ′ ″				
98	*Kedar Kanta*,	95 51 18	95 51 16	9 997 739	5 414 680	259 824	
	Surkanda,	24 31 49	24 31 47	9 618 221	5 035 172	108 436	
	H. middle peak,		59 36 56	0 064 165	5 352 786	225 313	
99	*Kedar Kanta*,	96 26 08	96 26 06	9 997 255	5 414 779	259 884	
	Surkanda,	24 04 42	24 04 40	9 610 635	5 028 159	106 699	
	H. left peak,		59 29 13	0 064 738	5 352 786	225 313	
100	*Kedar Kanta*,	134 09 29	134 09 28	9 855 776	5 497 495	314 409	
	Surkanda,	14 54 14	14 54 13	9 410 260	5 051 979	112 714	
	L. No. 40,		30 56 20	0 288 933	5 352 786	225 313	
101	*Kedar Kanta*,	127 15 16	127 15 15	9 900 890	5 482 963	304 063	
	Surkanda,	16 36 10	16 36 09	9 455 956	5 038 029	109 151	
	d. No. 1, (No. 39),		36 08 37	0 229 287	5 352 786	225 313	
102	*Kedar Kanta*,	149 20 28	149 20 28	9 707 507	5 479 032	301 323	
	Bairát,		13 22 04	9 363 989	5 135 514	136 620	
	The Cone,		17 17 28	0 526 915	5 244 610	175 635	
103	*Kedar Kanta*,	148 37 36	148 37 36	9 716 556	4 474 655	335 232	
	Surkanda,		10 53 22	9 276 265	5 085 053	121 634	
	No. 46, (the Needle),		20 29 02	0 456 002	5 3[illegible] 786	225 313	
104	*Kedar Kanta*,		147 21 25	9 731 914	4 511 930	307 659	
	Chandpúr,		12 19 44	9 329 444	5 085 600	121 789	
	No. 46, (the Needle),		20 18 51	0 459 460	5 296 696	198 014	
105	*Surkanda*,	88 44 37	88 44 35	9 999 895	5 419 993	263 023	
	Black *E.*		25 04 30	9 627 170	5 047 268	111 429	
	Chandra Badaní,	66 10 56	66 10 54	0 038 660	5 381 438	240 679	
106	*Surkanda*,	62 36 17	62 36 15	9 948 338	5 329 657	213 627	
	C.		27 37 03	9 660 112	5 047 431	111 540	
	Chandra Badaní,	89 46 43	89 46 41	0 000 083	5 381 236	240 567	

No.	Names of Stations.	Observed Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides opposite.	Sides in Feet.	Remarks.
		° ′ ″	° ′ ″				
	Surkanda,	50 23 19	50 23 17	9 886 705	5 358 282	2[illegible] 183	
107	*Chandra Badaní*,	107 29 43	107 29 41	9 979 432	5 451 009	282 728	
	D.		22 07 02	0 424 232	5 047 345	111 484	
	Surkanda,	47 31 03	47 31 01	9 867 752	5 355 118	226 526	
108	*Chandra Badaní*,	111 36 08	111 36 06	9 968 374	5 463 740	290 897	
	U.		20 52 53	0 448 021	5 047 315	111 484	
	Chúr,		20 58 27	9 553 808	4 753 [illegible]	[illegible]	
109	*Whartú* fort,	44 50 12	44 50 11	9 848 241	5 047 795	111 634	
	Túngrú peak,	114 11 22	114 11 21	0 039 912	5 159 642	144 425	
	Whartú fort,	72 59 43	72 59 47	9 980 588	5 153 295	142 330	The distance from which this triangle is calculated is taken from the 51.
110	*d* or Pyrdal. pk. hither range,		22 23 43	9 580 913	4 753 781	56 726	
	Túngrú peak,	84 36 30	84 36 29	0 001 926	5 170 781	148 177	
	Whartú fort,	75 53 44	75 53 44	9 986 706	5 154 367	142 681	
111	*Túngrú* peak,	81 26 10	81 26 10	9 995 131	5 162 792	145 476	
	a hither range,		22 40 06	0 414 093	4 753 568	56 698	Mean of 109 & 110.
	Whartú fort,	75 05 20	75 05 20	9 985 124	5 152 210	141 971	
112	*Túngrú* peak,	82 12 40	82 12 40	9 995 975	5 163 061	145 566	
	b. hither range,		22 42 00	0 413 518	4 753 568	56 698	
	Whartú fort,	74 20 14	74 20 14	9 983 567	5 158 662	144 099	
113	*Túngrú* peak,	83 24 00	83 24 00	9 997 112	5 172 207	148 664	
	c. hither range,		22 15 46	0 421 537	4 753 568	56 698	
	Whartú fort,	72 24 30	72 24 30	9 979 200	5 171 806	148 527	
114	*Túngrú* peak,	86 15 10	86 15 10	9 999 070	5 191 676	155 480	
	e.		21 20 20	0 439 038	4 753 568	56 698	
	Whartú fort,	71 30 10	71 30 10	9 976 964	5 165 013	146 232	
115	*Túngrú* peak,	86 55 25	86 55 25	9 999 374	5 187 463	153 975	
	f.		21 34 25	0 434 511	4 753 568	56 698	

No.	Names of Statoins.	Observed Angles Reduced to Centre.	Angles for Calculation.	Logarithmic Sines.	Logarithms of Sides opposite.	Sides in Feet.	Remarks.
		° ′ ″	° ′ ″				
	Whartú fort, ...	69 33 30	69 33 30	9 971 753	5 168 941	147 550	
116	*Túngrú* peak, ...	89 20 15	89 20 15	9 999 971	5 197 159	157 455	
	g..................		21 06 15	0 443 620	4 753 568	56 698	
	Whartú fort, ...	67 45 30	67 45 30	9 966 421	5 178 830	150 949	
117	*Túngrú* peak, ...	91 53 50	91 53 50	9 999 762	5 212 171	162 993	
	h..................		20 20 40	0 458 841	4 753 568	56 698	
	Whartú fort, ...	66 34 11	66 34 11	9 962 627	5 216 737	164 717	
118	*Túngrú* peak, ...	95 01 25	95 01 25	9 998 328	5 252 438	178 705	
	j..................		18 24 24	0 500 542	4 753 568	56 698	
	Whartú fort, ...	112 42 37	112 42 37	9 964 95	5 333 37	215 460	
119	*Túngrú* peak, ...	53 14 27	53 14 27	9 903 72	5 272 14	187 130	
	Western *F.* (No. 2), ...		14 02 56	0 614 85	4 753 57	56 698	
	Whartú fort, ...	125 57 07	125 57 07	9 908 22	5 287 08	193 680	
120	*Túngrú* peak, ...	40 20 24	40 20 24	9 811 12	5 189 98	154 875	
	No. 8, ...		13 42 29	0 625 29	4 753 57	56 698	
	Whartú fort, ...	127 37 56	127 37 56	9 898 69	5 293 06	196 370	
121	*Túngrú* peak, ...	39 08 57	39 08 57	9 800 27	5 194 64	156 550	
	Black peak, No. 9, ...		13 13 07	0 640 80	4 753 57	56 698	

Table of Differences of Level of the Principal Stations and Peaks in the Gerhwal Survey.

No.	Names of Stations.	Observed Elevation and Depression.	Tangent of Mean 1.	Distance in Feet.	Logarithm.	Log. Diff. of Level.	Diffr. of Level in Feet.	Arc of Distance.	Refraction.	Ratio
1	*Chúr*, ... *Belville*, ...	° ′ ″ 2 15 18 D 1 32 01 E	8,519 52	324 413	5,511 14	4,030 66	10 731	′ ″ 53 32	′ ″ 5 07,-	1/10,44
2	*Bairát*, ... *Belville*, ...	1 44 27 D 1 09 17 E	8,402 67	259 103	5,413 47	3,816 14	6 548	42 43½	3 46,8	1/11,29
3	*Bhadráj*, ... *Belville*, ...	1 52 00 D 1 20 42 E	8,447 69	228 953	[illegible]	[illegible]	0418,6	37 43	3 12,5	1/11,73
4	*Surkanda*, ... *Belville*, ...	1 59 14 D 1 20 44 E	8,463 78	286 183	5,456 64	3,920 42	8325,6	47 03·9	4 17	1/10,99
5	*Chandpur*, ... *Belville*, ...	1 53 08 D 1 15 40 E	8,438 81	274 914	5,439 20	3,878 01	7551,1	45 21·2	3 25,8	1/11,51
6	*Surkanda*, ... *Bhadráj*, ...	1 03 45 D 0 48 11 E	8,211 69	108 854	5,036 81	3,248 53	1772,3	17 52·6	1 09,6	1/15.41
7	*Surkanda*, ... *Bairát*, ...	0 54 15 D 0 35 51 E	8,117 45	127 502	5,105 52	3,222 97	1671,0	20 57·5	1 16,5	1/16,44
8	*Surkanda*, ... *Chandpur*, ...	0 26 37 D 0 05 15·5D	7,492 43	225 606	5,353 35	2,845 78	701	37 04·9	2 36	1/14,26
9	*Uch[illegible]ú*, ... *Surkanda*, ...	1 39 42 D 1 10 00 E	8,392 47	204 752	5,311 23	3,703 70	5 054,8	33 40·9	2 00	1/16,84
10	*Surkanda*, ... *Chundir Budunee*, ...	0 57 45 D 0 41 31·4E	8,159 55	111 508	5,047 31	3,206 86	1 610,1	18 19·2	1 02,8	1/17.50
11	*Surkanda*, ... *Chandee Pahar*, ...	2 36 16 D 2 10 55 E	8,621 13	179 065	5,253 03	3,874 16	7 484,4	29 32	2 05,5	1/14,12
12	*Chúr*, ... *Bairát*, ...	1 35 17·5D 1 09 54 E	8.380 79	170 286	5,231 18	3,611 97	4 092,3	28 00·1	1 18,3	1/21.46

Table of Differences of Level, &c.—Continued.

No.	Names of Stations.	Observed Elevations and Depression.	Tangent of Mean 1.	Distance in Feet.	Logarithm.	Log. Diff. of Level.	Diffr. of Level in Feet.	Arc of Distance.	Refraction.	Ratio.
13	Chandpur, ... Bairár, ...	0° 40′ 35″·5 D 0 26 07·5 E	7,986 94	98 169 5	4,991 97	2,978 91	952,6	16′ 08″	0 50″	1/19.36
14	Bairár, ... Bhadráj, ...	0 10 50 D 0 05 10 E	7,366 8	38 380	4,584 8	1,951 6	89,5	6 20 4	0 20,2	1/18,84
15	Kedarkanta, ... Bairát, ...	1 52 13 D 1 27 03 E	8,462 25	175 565	5,244 44	3,706 69	5 089,7	28 56 4	1 53,2	1/15,34
16	Uchalárú, ... Bairát, ...	1 54 00 D 1 21 29 E	8,453 92	234 888	5,370 86	3,824 78	6 680,	39 19 7	3 24,7	1/11.53
17	Chandpur, ... Bhadráj, ...	0 38 34 D 0 20 23 E	7,933 18	123 944	5,093 22	3,026 40	1 062,7	20 23 6	1 06,3	1/18,45
18	Bhadráj, ... Jytuk, ...	0 59 30 D 0 32 05 E	8,124 54	199 567	5,300 09	3,424 63	2 658,5	32 46 4	2 40,7	1/12,24
19	Chúr, ... Chandpur, ...	2 30 41 D 2 20 12 E	8,626 30	73 986	4,869 15	3,495 45	3 129,3	12 10 5	0 50,8	1/14,38
20	Chúr, ... Whartú, ...	0 34 49 D 0 13 32 E	7,847 10	144 458	5,159 74	3,006 84	1 015,9	23 49 8	1 16.3	1/15,54
21	Chúr, ... Jytuk, ...	3 52 30 D 3 37 55 E	8,816 95	104 141	5,017 62	3,834 57	6 832,4	17 09 8	1 17,5	1/13.25
22	Whartú, ... Túngrú, ...	0 39 17 D 0 30 24 E	8,005 79	56 699	4,750 53	2 756 32	570,6	9 16	0 11,5	1/45.4

Snowy Peaks—with Data.

No.	Names of Stations.	Observed Elevation.	Arc of Distance.	Corrected Elevation.	Tangent.	Distance in Feet.	Logarithm.	Log. Diff. of Level.	Diff. of Level in Feet.	Height above the Sea.
1	*Uchalarú, F.*	° ′ ″ 5 40 25	′ ″ 12 39	° ′ ″ 5 45 56	9 004 19	76,673	4 884 64	3 888 83	7,742	21,884
	Ditto, G.	5 03 53	10 58	5 08 41	8 954 41	66,481	4 822 70	3 777 11	5,987	20,129
	Ditto, C.	5 14 08	13 28	5 20 02	8 97[illegible] 18	81,731	4 912 39	3 882 57	7,631	21,773
	Ditto, Q.	3 29 15	40 14	3 35 40	8 798 08	88,985	[illegible] 949 32	3 747 40	5,590	19,732
5	*Ditto, J.*	1 32 27	15 28	1 39 13	8 460 43	94,048	4 973 35	3 433 78	2,715	16,857
	Ditto, great *E.*...........	9 34 55	06 25·6	9 37 44	9 229 57	39,097	4 591 48	3 821 05	6,623	20,765
	Kedar Kanta, L..........	3 19 43	18 34·8	3 27 51	8 782 00	112,714	5 051 98	3 833 98	6,823	19,352
	Ditto, No. 39, ...	3 25 47	17 58	3 33 39.6	8 793 97	109,151	5 038 03	3 832 00	6,792	19,321
	Ditto, great *E.*..........	3 46 50	19 40	3 55 26	8 836 27	119,819	5 078 52	3 914 79	8,218	20,747
10	*Kedar Kanta, H.* left peak,	4 04 03	17 31·5	4 11 43	8 865 41	106,699	5 028 16	3 893 57	7,827	20,356
	Ditto, H. middle peak, ...	4 04 53	17 48·6	4 12 31	8 866 79	108,436	5 035 17	3 901 96	7,979	20,508

Snowy Peaks—*with Data*.—Continued.

No.	Names of Stations.	Observed Elevation.	Arc of Distance.	Corrected Elevation.	Tangent.	Distance in Feet.	Logarithm.	Log. Diff. of Level.	Diff. of Level in Feet.	Height above the Sea.
	Kedar Kanta, *C*.	° ′ ″ 2 06 12	° ′ ″ 18 18·5	° ′ ″ 2 22 13	8 618 30	222,954	5 348 21	3 966 51	9,258	21,787
	Ditto, the Cone, ...	3 23 30	22 28	3 33 20	8 793 34	136,620	5 135 51	3 928 85	8,489	21,018
	Surkanda, *C*.	2 09 23	21 06·5	2 27 51	8 633 81	256,421	5 408 90	4 012 71	11.033	20,144
15	*Ditto*, *F*.	2 34 36	41 52·9	2 52 55	8 701 93	254,542	5 405 76	4 107 69	12,814	21,925
	Ditto, *Q*.	2 24 54	37 27·7	2 41 18	8 671 68	227,729	5 357 42	4 029 10	10,693	19,804
	Ditto, *A*. No. 1, ...	1 10 20	1 17 10·4	1 44 16	8 482 00	470,028	5 672 12	4 154 12	14,260	23.371
	Ditto, *A*. No. 2, ...	1 08 32	1 26 55·3	1 46 34	8 493 13	590,384	5 723 77	4 216 90	16,478	25,589
	Ditto, *Moira*, ...	2 28 28	0 45 23·2	2 48 19	8 690 20	275,933	5 440 80	4 131 00	13,521	22,632
20	*Surkanda*, *B*. middle peak.	2 01 43	54 53	2 25 44	8 627 54	334,068	5 523 83	4 151 37	14,170	23,281
	Ditto, *P*.	1 00 35	1 22 08	1 36 31	8 448 44	500,175	5 699 12	4 147 56	14,046	23,157
	Kedar Kanta, No. 46, ...	2 50 27	0 20 04	2 59 14	8 717 53	121,712	5 085 33	3 802 86	6,351	18,884

Snowy Peaks—with Data.—Continued.

No.	Names of Stations.	Observed Elevation.	Arc of Distance.	Corrected Elevation.	Tangent.	Distance in Feet.	Logarithm.	Log. Diff. of Level,	Diff. of Level in Feet.	Height above the Sea.
	Kedar Kanta, Kot Gerh pk.	° ′ ″ 0 35 56	° ′ ″ 0 46 43	° ′ ″ 0 56 23	8 214 92	283,672	5 452 82	3 667 74	4,653	17,186
	Chúr Raldeng, ...	1 05 44	0 59 49	1 31 54	8 427 14	363,580	5 560 60	3 987 74	9,722	21,251
25	*Whartú,* pyramidal peak,	2 24 43	0 24 21	2 35 22	8 65[illegible] 38	148,180	5 170 78	3 826 16	6,701	17,214
	Surkanda, D.	2 27 11	0 46 26	2 47 30	8 688 08	282,728	5 451 01	4 139 09	13,775	22,894
	Chandra Badaní, D.	3 35 16	0 37 34	3 51 42	8 829 31	228,183	5 358 28	4 187 59	15,403	22,912
	Surkanda, U.	2 04 43	0 47 49	2 25 38	8 627 33	290,300	5 463 7[illegible]	4 091 07	12,333	21,452
	Whartú, western *F.*	2 15 49	0 30 51	2 29 19	8 638 10	187,130	5 272 14	3 910 24	8,133	18,646
30	*Ditto,* black peak, ...	1 50 05	0 25 51	2 01 24	8 548 12	156,550	5 194 64	3 742 76	5,530	16,043
	Ditto, Kot Gerh peak, ..	2 14 31	0 25 58	2 25 53	8 627 99	157,500	5 197 27	3 825 26	6,687	17,200
	Túngrú, western *F.*	2 03 00	0 35 33	2 18 34	8 605 63	215,460	5 333 37	3 939 03	8,690	18,632
	Kedar Kanta, black *E.* ...	3 45 03	0 24 34	3 52 03	8 829 96	125,240	5 097 74	3 927 70	8,466	20,995

Snowy Peaks—with Data.—Continued.

No.	Names of Stations.	Observed Elevation.	Arc of Distance.	Corrected Elevation.	Tangent.	Distance in Feet.	Logarithm.	Log. Diff. of Level.	Diff. of Level in Feet.	Height above the Sea.
	Kedar Kanta, low E.	° ′ ″ 3 41 23	° ′ ″ 0 18 16	° ′ ″ 3 49 23	8 824 92	111,231	5 046 23	3 871 14	7,433	19,962
35	*Surkanda, H.* right peak,..	2 11 21	0 42 58	2 30 09	8 640 57	260,745	5 416 21	4 056 78	11,397	20,508
	Ditto, *H.* midle peak,	2 09 43	0 42 50	2 28 27	8 635 57	259,883	5 414 78	4 050 35	11,230	20,341
	Uchalárú, Q.—C.	3 32 56	0 13 28·5	3 38 50	8 804 43	82,021	4 913 92	3 718 35	5,228	19,370
	Ditto, F.—C.	4 57 30	0 13 51	5 03 24	8 947 13	84,365	4 926 20	3 873 33	7,470	21,612

THE preceding determinations may be so arranged as to draw from them a very satisfactory mean value for the height of any one of the mountain stations (the *Chúr*) above that in the plains, *Belville:* those that are nearest to each other, being supposed most correct as free from the uncertainty of refraction, and having larger angles of elevation, and depression, answering to equal differences of level.

		Feet.	
Thus,	*Bairát* is above *Bhadraj,*	89	
	Chandpúr above *Ditto,*	1062	
	Ditto above *Bairát,*	973	
	By direct calculation, ...	953	
	Mean,	963	
Again,	*Surkanda* is above *Bhadraj,*	1,772	
	Bairát above ditto, ...	89	
	Surkanda above *Bairát,*	1,683	
	By direct calculation, ...	1,671	
	Mean,	1,677	
	Chandpúr above *Bairát,*	963	
	Surkanda above *Chandpúr,*	714	(2 Results).
	By direct calculation, ...	701	(1 Result).
	Mean,	710	

		Chúr above *Bairát.*
Chúr above *Chandpur*, ...	3,128	
Chandpur above *Bairát*, ...	963	
	——	4,091
Chúr above *Jytek*, ...	6,833	
Jytek below *Bhadráj*, ...	2,658	
Bhadráj below *Bairát*, ...	89	
	——	4,086
By direct calculation,		4,092
Mean,		4,090
		Chúr above *Belville.*
Chandpur above *Belville*, ...	7,550	
Chúr above *Chandpur*, ...	3,128	
	——	10,678
Bairát above *Belville*, ...	6,549	
Chúr above *Bairát*, ...	4,090	
	——	10,639
Bhadráj above *Belville*, ...	6,419	
Chúr above *Bairát*, ...	4,090	
Bairát above *Bhadráj*, ...	89	
	——	10,589
Surkanda above *Belville*, ...	8,326	
Ditto above *Chandpur*, ...	710	
Chúr above *Ditto*, ...	3,128	
	——	10,744
By direct calculation,		10,731
Mean of 5 values,		10,676

This then may be taken as the probable height of the *Chúŕ* station above *Belville.* To which adding* 1013 feet for the height of the latter, above the sea as determined from barometrical calculation, we get finally for the height of the *Chúŕ* station above the sea 11,689 feet. From this the following mean values may be fixed by applying the several mean differences of level before found.

	Feet
Chúŕ station above the sea,...............	11,689
Bairát,...............................	7,599
Bhadráj,...............................	7,510
Surkanda,...............................	9,271
Kédar Kánta,...............................	12,689
Uchalárú,...............................	14,302
Jytek,...............................	4,854
Chandpur,...............................	8,561

The refractions it appears are greater where one of the stations is in the plains.

Thus, *Belville-Chúŕ* give,...... $\frac{1}{10.44}$
Bairát,......... $\frac{1}{11.29}$
Surkanda,...... $\frac{1}{10.99}$
Bhadráj,........ $\frac{1}{11.73}$
Chandpur,....... $\frac{1}{11.51}$

Mean, $\frac{1}{11.19}$

* The first calculations gave but 853 feet for this height, but the observations were much less complete than those subsequently made as described below. It has therefore been necessary to cancel the first list of results, and to substitute a new one in which the difference of 160 feet has been added to the elevations formerly inserted, and a number of additional observations have been appended.

WHILE for heights varying from 7,000 to 14,000 we have,

Surkanda-Bhadráj,..........	$\frac{1}{15.41}$
Bairát,............	$\frac{1}{16.44}$
Chandpur,........	$\frac{1}{14.26}$
Uchalárú,........	$\frac{1}{16.84}$
Chandra Badaní,..	$\frac{1}{17.50}$
Chúr-Bairát,...........	$\frac{1}{21.46}$
Chandpur,........	$\frac{1}{14.38}$
Whartú fort,......	$\frac{1}{18.74}$
Bairát-Chandpur,........	$\frac{1}{19.36}$
Bhadráj,..........	$\frac{1}{18.84}$
Kédar Kánta,....	$\frac{1}{15.34}$
Uchalárú,.........	$\frac{1}{11.53}$
Chandpur-Bhadráj,..........	$\frac{1}{18.45}$
Mean,	$\frac{1}{16.81}$

Now although from the elevations of the snowy peaks being far beyond 14,000 feet, we might safely take a much smaller ratio than $\frac{1}{16}$, yet to be within the mark, we will content ourselves with that quantity. The extreme difference in the coefficent, is $\frac{1}{11}$ to $\frac{1}{21}$ that is nearly as 2 to 1. Supposing an arc of 60′, this will be either 6′ or 3′, leaving a doubt of 3′, and this generally on angles of 3° or $\frac{1}{60}$ of the height, that is of 10,000 feet = 170 feet. And it must be recollected that this is taking not a fair view of the question, but an exceedingly unfavorable one, for it might be safely asserted that in

no case is the refraction in viewing a snowy peak from an elevation of 7,000 feet, so great as $\frac{1}{18}$ of the arc, while the distance also is never 60'.

THE following table, contains all the elements of the calculation of the elevations of the snowy peaks. The formula is $H = D$ tang. $(E + \frac{1}{2}\delta - \frac{1}{16}\delta)$ where H, means the height, D the distance in feet, δ the angle subtended between the verticals of the two places, and E the observed altitude. In finding δ allowance has been always made for the figure of the earth by using table 3 of the appendix.

ACCOMPANYING there is given a catalogue of latitudes and longitudes of all the positions that are trigonometrically determined, with the elevations of as many as have yet been fixed. The formula used is sufficiently explained in the appendix. It only remains to say, that the latitude of *Belville* has been assumed as that likely to be nearest the truth, being determined from a greater number of observations, and under more favorable circumstances.

THE *Azimuth* of the *Chúr* station from *Belville*, was determined, by a number of double elongations of the pole star, made by both observers, with the circle, to be 3° 25' 05" W. of N. *Azimuths* were also observed from the *Chúr*, from *Surkanda*, *Bairát*, *Uchalárú* and *Kédar-Kánta*. The several differences of *Azimuth* being calculated by the formula, and tables given in the appendix, and applied to these, the differences are in no case found to exceed what may be fairly attributable to observation, that is to say, they never exceed $\frac{1}{2}$. But as all, except the *Azimuth* from *Bairát*, were

observed with the theodolite and deduced from comparisons with the sun, (a method not capable of the same precision as that of elongations, it was thought more correct to confine ourselves to the original *Azimuth* from *Belville,* determined in so much more satisfactory a manner. The others indeed were principally observed as checks, and to be an assurance against the intrusion of any errors, not properly belonging to the subject.

Barometrical Observations to determine the Height of the Station near Sahâranpúr, *above the level of the Sea.*

THIS important point it is hoped is satisfactorily settled from the eighteen corresponding barometrical observations made at *Saháranpúr* and *Calcutta,* for that express purpose, with correct mountain barometers, in which the level of the mercury in the cistern can always be adjusted. As for want of the verification of the zero of their scales, the observations usually made in *Calcutta* for meteorological purposes, are not sufficiently correct, to use as correspondents where differences of height are desired: we rather chose, to determine the differences of height of *Saháranpúr,* and the sea, from the assumed mean height at which the mercury is supposed by philosophers to stand at the sea level, on an average of *the whole year,* but to render that mode of comparison, *perfectly correct,* it would be necessary, to have the observations, taken during twelve months at *Saháranpúr;* therefore, on the arrival of a *perfect* mountain barometer in *Calcutta,* an actual cotemporaneous comparison was immediately insti-

tuted, with a similar instrument at *Sahâranpúr* as noted below. The result, (all corrections made) is that **1013** feet, is the height of *Sahâranpúr* above the sea. Thus a more correct determination having been obtained, since this part of the paper, went to the press, it is substituted for the former *assumed* difference of level, and the present list is more accurate, and also contains more places, than the former, which will account for the circumstance, of several of the pages bearing the same number.

Sahâranpúr Cantonment, August 1821.						*Surveyor General's House at Chowringhee, Calcutta, August 1821.*			
Date.	*Hour.*	*Barometer.*	*Attached Thermometer.*	*Detached Thermometer.*	*Remarks.*	*Barometer.*	*Attached Thermometer.*	*Detached Thermometer*	*Remarks.*
		Inches.	o	o		Inches.	o	o	
7th	4 P. M.	28·654	87·	88·5	Fair.	29.652	87	85	Cloudy.
8th	8 A. M.	·732	83·7	85·6	Ditto.	·712	83	83	Clear.
	10½	·730	85·7	90·3	Ditto.	·720	85	84	Ditto.
	4 P. M.	·610	84·9	85·0	Cloudy.	·700	85	84	High wind.
9th	8 A. M.	·713	80·7	78·1	A little rain.	·645	82	82	Stormy.
	10	·739	81·6	79·0	Cloudy and threatening.	·657	83	82	Ditto.
	12	·709	85 7	85·9	Fair, E. breeze.	·675	85	84	Fresh breeze.
	4 P. M.	·620	85·1	86·6	Ditto.	·575	85	84	Ditto, with rain.
10th	10 A. M.	·789	79·2	78·0	Cloudy, thunder.	·750	84	83	Cloudy, showers.
	12	·775	79·4	76·6	Raining.	·685	84	83	Raining.
	4 P. M.	·680	81·8	85·6	Fair.	·628	84	83	Fair.
11th	10 A. M.	·779	83·1	85·3	Raining heavily.	·815	84	83	Cloudy and close.
12th	1 P. M.	·723	84·5	84·5	Cloudy.	·800	84	83	Ditto.
	4	·681	84·	84·	Ditto.	·700	84	83	
13th	12	·668	80·8	79·7	Ditto.	·800	84	83	Rain, close.
	4 P. M.	·639	79·4	78·1	Violent wind.	·700	84	83	Ditto.
14th	8 A. M	·700	78·9	77·2	Light drizzle.	·715	82	81	Fresh breeze.
	10½	·810	80·0	79·2	High wind, ditto.	·720	82	81	Ditto.
	Mean,	28·705	82·5	82·6		29·705	84	83	

Latitudes, Longitudes and Elevations, of principal Peaks and Stations in the Survey.

THE positions of the stations, whether of the small, or large series of triangles, are, it is thought true, (as far as *differences* of latitude and longitude are concerned), to a fraction of a second. None of the snowy peaks can be erroneous to the amount of 2″. But the *secondary* points, are not equally true, with those, and having been fixed in various ways, they possess various degrees of correctness. The maximum error, however cannot exceed 6″ or 8″, which for geographical purposes is sufficient. It is to be remarked, that on such points, no others are dependent, consequently any errors stop with themselves, and are not transferred to new results, so as to accumulate. As to the *absolute* latitudes and longitudes, the former, it is evident, cannot be determined with the greatest precision with portable instruments, nor *all* the latter without corresponding observations at some known Observatory, which we are as yet without. The error of the former, however cannot exceed 10″ at the *utmost*, nor that of the latter 4′ or 5′ equal to 16s or 20s of time.

1. Stations of the Large Series of Triangles.

No.	Stations.	Latitude.	Longitude from Greenwich	Elevation.	District or State.	Remarks.
		° ′ ″	° ′ ″	Feet.		
1	*Belville*,........	29 57 10	77 32 12	1013	*Sahâranpúr, Doab*,..	The residence of R. GRINDALL, Esq Judge and Magistrate. This is the principal station of the survey, where all the most valuable observations, whether of latitude, longitude or *Azimuth*, have been made. It is $1\frac{1}{2}$ miles S. by E. of the town of *Sahâranpúr*.

Latitudes, Longitudes and Elevations,—Continued.

No.	Stations.	Latitude.	Longitude from Greenwich.	Elevation.	District or State.	Remarks.
		° ′ ″	° ′ ″	Feet.		
2	*Chandra-Badaní*,	30 18 03	78 36 27	7661	*Rimola*,..........	A peak of the ridge, separating the vallies of the *Alacananda* and *Bhagirat'hí*. There is a small temple of some sanctity, dedicated to KALÍ. Its summit is clay slate, and bare of trees.
3	*Súrkanda*, ...	30 24 28	78 16 33	9271	*Ditto*,............	This peak is part of the separating ridge of the *Jumna* and *Bhagirat'hí*. It overlooks the *Dún*, and is but 15½ miles in a direct line, from the cantonment of *Déhra*; the *Monal* or *Golden* and other varieties of pheasants abound. The summit is composed of a dull greyish stone, coarsely granulated, and having a conchoidal fracture. It is semi-hard.
4	*Bhadráj*, ...	30 28 34	77 56 23	7510	*Jionpúr*,..........	This peak rises immediately from the *Dún*, on one side, and from the *Jumna* on the other. It is connected with *Súrkanda*. Its summit consists of the same rock as *Súrkanda*.
5	*Buirát*, ...	30 34 51	77 55 26	7599	*Jaunsár*,..........	Fort, on a peak between the rivers *Tons* and *Jumna*. *Jaunsár* was formerly a *Purgunnah* of *Sirmor*, but was retained by Government with the *Dehra* and *Kyarda*, *Dúns*, and the contiguous *Pergunnah* of *Bowar*, after the expulsion of the *Gúrkhas*. Summit clay slate and quartz.
6	*Jeytek*, ...	30 35 25	77 19 10	4854	*Sirmor*,..........	Fort on peak invested by the *British* army under General MARTINDELL, in December 1814. The mountain is extremely steep, yet by the most surprising exertions, the heavy 18 pounders were dragged up it, as well as over several intermediate steep hills. Summit clay slate.
7	*Chandpúr*, ...	30 42 10	77 38 43	8561	*Sirmor*, ...	A peak between the *Tons* and *Giri* rivers. A small temple on the summit.
	Chúr station,.....	30 50 36	77 28 30	11689	*Júbal* and *Sirmor*,...	The pyramid built as a station mark. Fire wood is abundant and water is procured by melting the snow.
	High peak, ..	30 52 00	77 28 03	12149		This is a very remarkable peak, from being the highest central point, in the lower belt of mountains; and sending out ridges and spurs, and ramifications in every direction it appears conspicuously from whatever quarter viewed; Its summit is granite. The juniper and red currant, are found on it, and its northern-east

and most accurate calculation.* If then we can resort to a method of calculation, so true as to have regard to the deviation of the figure of the earth from the sphere, yet equally convenient and expeditious as though we had considered it to be a plane, we shall I conceive be justified in adopting it even though it may seem like affecting a degree of accuracy, of which the operations of such a survey are not susceptible. When there are two methods equally intelligible and equally short, one of which is but an approximation, and the other strictly accurate, there can be but one opinion as to which should be chosen. In the one we cut off every source of error but that of observation, and if we can do this without a greater expence of time, it would seem like courting error to choose the other. But those who have attempted these operations know how much will always attach itself to the work in the field, and how unnecessary it is to increase it by additions from other sources. The calculations of this survey have therefore all been made on the supposition of the earth's being an ellipsoid, and it is to be explained here what the nature is of the formulæ on which they have been conducted.

3. THE first step is to determine the dimensions of the earth and the degree of ellipticity, and this has been done by means of Colonel LAMBTON'S formulæ, given in the 12th Volume of the *Asiatic Researches.* The *Data* which have been adopted are those generally allowed to be the most unexceptionable, as they are the latest measurements, viz. the *French*

* "ON PEUT toujours concevoir un ellipsoide, tangent a chaque point dela surface terrestre "and sur lequel les mesures Geodesiques, les longitudes et les latitudes, a partir dupoint de contin-"gence dans unepetite etendue seraient les mémes qú'a cette surface." LA PLACE. MEC. CELESTE.

degree,* as determined by DE LAMBRE and MUHAIN. The *English* by Colonel MUDGE. The *Swedish* by SWANBERG and OFBERBOOM, and the *Indian* by Colonel LAMBTON. These were arranged to form three results as follows;

	Transverse Axis.	Ellipticity.
Indian degree compared with *Swedish* gives, ...	1·003270	$\frac{1}{305{\cdot}81}$
English degree compared with *Swedish* and *Indian,*	·003311	$\frac{1}{302{\cdot}02}$
French degree compared with *Ditto* *Ditto,*	·003218	$\frac{1}{310{\cdot}75}$
Mean result,	1·0032663	$\frac{1}{306{\cdot}157}$

WITH this ellipticity and by Colonel LAMBTON'S formulæ, the equatorial degree was calculated, substituting each of these 4 degrees in the equation. This furnished four results as follows;

	Fathoms.
By the *English* degree,............	60451·8
French,....................	74·6
Indian,....................	56·5
Swedish,..................	57·2
Mean,	60460

* THE arc from which this degree is deduced has been since extended by Messrs. BIOT and ARRAGO to 12°, having it's middle point little differing from the mean degree 45°. As however Captain HODGSON fixed on the ellipticity, which we were to use previous to seeing any account of this measurement, and as the difference which would arise from admitting it into the calculation would have been very trifling, it was not thought necessary to loose so much time as a revision of all our work would have required, especially considering the little effect a small change in the ellipticity would produce in the results.

WITH this mean equatorial degree of 60460 fathoms, and the mean ellipticity of $\frac{1}{306 \cdot 157}$, the degrees of latitude, and of the perpendicular to the meridian, were calculated by means of Colonel LAMBTON's formulæ, for latitudes 30°, 31° and 32°, being the limits of the survey. The results are given in tables 1, 2. Table 3, gives the difference of the degrees of latitude, and oblique degrees calculated from the same *Data* by means of Mr. DALBY's formulæ given in the 2d Volume, trigonometrical survey of *England* and *Wales*.* These tables will be often referred to.

4. WHEN from given distances and *Azimuths* we are to calculate differences of longitude and latitude, an attention to the real figure of the earth is required to avoid considerable errors, as is evident from the manner in which longitudes and latitudes are reckoned: when however we are to calculate the sides and angles of triangles of comparatively small extent, it is certain that a disregard of the deviation of the figure from a sphere cannot occasion any error.† Distances therefore on the ellipsoid if they be not too great, may be determined by supposing them referred to a sphere. This is an important distinction and not to be forgotten. The resolution of small spherical triangles has been made equally simple, as those on a plane, by the beautiful theorem of LEGENDRE, in which he proves that by deducting $\frac{1}{3}$ of the excess of the three spherical angles above 180°, from

* THERE are shorter and more convenient formulæ (approximate however), which were not so familiar at the time as those used which are strictly correct.

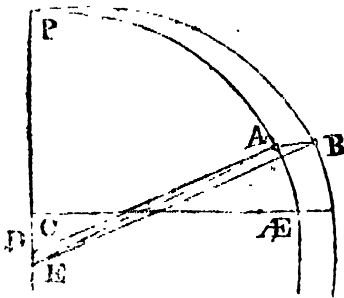
† IT has been demonstrated by M. LEGENDRE, that the difference between the spherical and spheroidecal angles in the largest triangles that occurred in the *French* survey, does not amount to $\frac{1}{10}$ of a second.

each of them we obtain three angles, which are those of a plane triangle, having it's sides respectively equal to those of the original spherical triangle. The application of this rule is so simple as to require no explanation; all that is necessary being a table of the spherical excess as it is called, which being very small in most cases, and proportional to the area of the triangle, may be determined sufficiently near a priori. This is given in table 4.

5. ALTHOUGH this theorem be a very convenient one, yet it is not by any means indispensible. It is easy to apply the common spherical analogies to small triangles, and this without any extension of the tables; by considering the sines and tangents as referred to a radius whose length is equal to that of the sphere, and expressed in the same measure as the sides of the triangle. The sines and tangents of small arcs, differ so little from the arcs themselves, that it appears to be the most direct as well as the easiest way to find them by means of those differences. Thus the logarithmic sine, (BONNYCASTLE's Trigonometry) $=$ Log. arc $- \frac{1}{M} \left(\frac{a^2}{2.3} r^2 + \frac{a^4}{2^2.3^2} 5 r^2 \text{ \&c.} \right)$ and Log. tang. $=$ Log. arc $+ \frac{1}{M} \left(\frac{a^2}{3 r^2} + \frac{7 a 4}{2.3^2} 5 r^4 \text{ \&c.} \right)$ The first terms of these series are sufficient for our purpose, and taking these it is evident that the difference of the tangent from the arc is double the difference of the sine; that in the former case it is additive, in the latter subtractive. All that is necessary then, is to calculate $\frac{a^2}{r^2} \frac{1}{3 M \cdot r}$, being the radius of the earth, and $\frac{1}{M}$ being the reciprocal of the logarithmic modulus $= 2{\cdot}302581$. Table 5, gives this correction for the probable distances of the survey. For sines, half of it is to be subtracted from

the logarithm of the distance in feet, and for tangents it is to be added. By means of this table, the calculation of small spherical triangles become as easy as plane ones, and this without any reference to the sperical excess, which is sometimes troublesome.

6. It is now to be considered what effect the figure of the earth will have on the determination of differences of latitude, longitude and *Azimuth*. In the first place it is very evident that the distance of any point, from the meridian and perpendicular of another, may be found without sensible error by considering the earth as a sphere (Art. 4). This then gives the latitude of one end of the perpendicular to the meridian; to find that of the other with the difference of longitude, and *Azimuth* is the second step.



Let *P C Æ* represent part of the elliptic meridian, *P* being the pole and *C* the centre of the earth. Let *A B* be the given distance from the meridian being at right angles to *P B*. It is required from the latitude of the point *B*, and the distance *A B* to determine first, the latitude of *A*: secondly, the difference of longitude or angle at *P*, and thirdly, the *Azimuth* of *B* from *A*.

At the point *B* draw the radius of curvature *B E*,* intersecting the

* If we suppose the earth to be cut at any point by a plane perpendicular to the meridian, in that point the centre of curvature of this section, at the point where it cuts the meridian, is the point in which the direction of gravity or of the plumb line intersects the axis of the earth. Playfair's Outlines of Natural Phil. p. 55. § 62. vol. 2d.

axis in *E*. Join *A E*, also *A B*. With the radius *B E* find the value of the angle *A E B*. There are then given in the solid angle *P E A B*, the two plane angles *A E B*, *B E P* (Co-lat. *B*), and the inclination of their planes $= 90^{\circ}$ to find the third angle *P E B*, and the inclination of it's plane with each of the others. But this is evidently that case of right angled triangles, in which the base and perpendicular are given to find the hypothenuse and the angles.

7. It is however to be remarked that though the inclination of the planes *P A E*, *P B E* be really the difference of longitude of *A B*, yet the other results of the spherical analogy do not equally answer for the spheroid. For the angle *P E A* which is that found by spherical computation, is not strictly speaking the Co-latitude of *A*. The true Co-latitude of this point is the angle formed by the vertical *A D* with the polar axis, that is the angle *P D A*. The difference of the two angles is *D A E*, and this is the correction to be applied in order to have the true Co-latitude in the spheroid.* Likewise is it evident that the inclination of the planes *P E A*, *A E B* is not the real *Azimuth* of the point *B* from *A*, this being determined by the angle which the vertical plane passing through *A*, forms with the meridian that is to say by the inclination of the planes *A D B*, *P D A*. It is true, that each of these results may for all practical purposes be supposed the measure of the Co-latitude and *Azimuth*, but it was thought necessary to make this remark and to give an expression for the two cor-

* It is not to be supposed that this is the only effect which the spheroidal figure has on the difference of latitude. It has much more; the value of the angle *A E B*, depending altogether on the degree of ellipticity.

rections, in order to shew that the error is really too small to be worth attending to.

8. This then is the principle, on which the determination of the differences of latitude, longitude and *Azimuth*, of the two ends of an arc of distance, on the spheroid, is founded. The whole is reduced by considering the matter in this way, to the resolution of a right angled spherical triangle. All that is required, being the Radii of curvature of the perpendicular to the meridian, for the points *A* and *B*, and the distance of their points of intersection in the polar axis *D E*. The former are contained in Table 2, and the latter in Table 6, calculated from the formula $2'' c$ (sine λ — sine λ') where $2\ c$ means the difference of the axes and λ, λ', the latitudes of the points *B A*. It may be more conveniently expressed as follows:

$$D\ E = 2\ c\ d\ L, \text{ sine } 1'' \text{ Cos } (\lambda + \tfrac{1}{2}\ d\ L).$$

9. The problem being thus simplified and reduced to the resolution of a common spherical analogy, we may next inquire whether the received formula may not in the cases under consideration, be rendered something more convenient in calculation, by employing the substitutions and developments, which the arithmetic of sines offers.

10. In the spherical triangle *P A B* right angled at *B*, we have the sides *P B*, (Co-latitude *B*). *A B* (distance from the meridian reduced to ° ' and ") to find the third side *P A* (Co-latitude of *A*), and the angles *P* (diff. long.) *P A B* *Azimuth* of *B* from *A*.



PUT L = the latitude of B; and $\acute{L}$ that of A, L being $= \acute{L} + d\,L$. Let μ be the distance from the meridian in feet, and δ the value of it in degrees, and = $A\ B\ P$ the difference of longitude, and $P\ A\ B = 90 - dz$. We have, (BONNYCASTLE's Trigonometry, p. 407).

$$\text{Tang. } \tfrac{1}{2}\, d\,L = \text{tang. } \tfrac{2\,1}{2}\,\delta,\ \text{tang. } \tfrac{1}{2}\,(L + \acute{L}). \qquad (1)$$

BUT the arc of 1 is the same as the tangent to 8 places of figures, and $d\,L$ can never exceed 1', we may therefore for tangent $\frac{1}{2}\,d\,L$ substitute its equivalent $\frac{\frac{1}{2}\,d''L}{R''}$, multiplying by 2 R'' we get,

$$d''L = 2\,R''\,\text{tang. } \tfrac{2\,1}{2}\,\delta,\ \text{tang. } \tfrac{1}{2}\,(L + \acute{L}). \qquad (2)$$

Now tang. $\frac{1}{2}\,(L + \acute{L})$ = tang. $L + \frac{1}{2}\,d\,L$, and tang. $L + \frac{1}{2}\,d\,L$ = (BONNYCASTLE's Trigonometry, p. 409). tang $L + \frac{\text{Sine } \frac{1}{2}\,d\,L}{\text{Cos } L,\ \text{Cos}\,(L + \frac{1}{2}\,d\,L)}$ on account of the extreme smallness of value of the second member, it is equivalent to $\frac{\text{Sine } \frac{1}{2}\,d\,L}{\text{Cos }^{2}L}$.

THE expression 2' becomes then,

$$d''L = 2\,R''\,\text{tang. } \tfrac{2\,1}{2}\,\delta,\ \text{tang. } L + \frac{2\,R''\,\text{tang. } \frac{2\,1}{2}\,\delta,\ \text{sine } \frac{1}{2}\,d\,L}{\text{Cos }^{2}L} \qquad (3)$$

SUBSTITUTING for sine $\frac{1}{2}\,d\,L$ it's approximate value.

Tang. $\frac{2\,1}{2}\,\delta$, tang. L it becomes

$$d''L = 2\,R''\,\text{tang. } \tfrac{2\,1}{2}\,\delta,\ \text{tang. } L + \frac{2\,R''\,\text{tang. } L\ \frac{2}{4}\,\delta,\ \text{tang. } L}{\text{Cos }^{2}L} \qquad (4)$$

THIS second member is evidently equal to the 1st multiplication by $\frac{\text{Tang. } \frac{2}{4}\,\delta}{\text{Cos }^{2}L}$. The formula may therefore be written, putting A = first term; $d\,L = 2\,R''$, tang. $\frac{2\,1}{2}\,\delta$, tang. $L + A\ \frac{\text{Tang. } \frac{2}{4}\,\delta}{\text{Cos }^{2}L}$.

PUTTING now tang. $\frac{1}{2}\delta = \frac{\delta''}{2R''}, f$* (when f means the factor, the logarithm of which is to be found in Table 5), and substituting this value in the preceding, we shall have,

$$d\,L'' = \frac{\delta''^2}{2R''}, f^2, \text{tang. } L + \frac{A\,\delta''^2}{L\,R''\,2\,\text{Cos}^2 L}.$$

f^2 being rejected from the second member as too small to affect it's value,

$$d\,L = \delta''^2 f^2\,\frac{\text{Tang. } L}{2R''} \times \frac{A\,\delta''^2}{L\,R''2}\,\text{Cos}\,^2L.$$

Now δ'' was originally put equal to $\frac{\mu}{p}$, p being the number of feet in one second of the perpendicular.

Restoring this value we have

$$d\,L = \mu^2 f^2\,\frac{\text{Tang. } L}{2R''p^2} \times \frac{A\,\mu^2}{L\,p^2\,R''}\,\text{Cos}\,^2L.$$

THE correction indicated in article 7, may be easily found as follows: It is evident (fig. 1), that $A\,D$: sine $D\,E\,A$: $D\,E$: sine correction. But $A\,D$ is the radius of curvature at $A\,(\rho)$. $D\,E\,A$ is the Co-latitude found by the above formula, and $D\,E$ has been shewn, (Art. 8) to be equal to $2\,c\,d\,L$, sine $1''$ Cos $(\lambda + \frac{1}{2}d\,L)$, on account of the smallness of the correction we are seeking, this is equivalent to $2\,c\,\frac{d\,L''}{R''}$ Cos L' putting then x = correction sought, and recollecting that sine $x'' = \frac{x''}{R''}$ we shall have

$$\rho : \text{Cos } L :: \frac{2\,c\,d\,L'',\ \text{Cos } L'}{R''} : \frac{x'}{R''}$$

$$\text{or } x'' = \frac{2\,c\,d\,L'',\ \text{Cos}\,2\,L.}{\rho}$$

THIS correction may be taken at once out of Table 7, it is additive as noticed, (Art. 7) to the Co-latitude found by the above, that is subtractive

* The value of f, varies of course with that of δ.

to the latitude, or it is additive to $d\,L$ the difference of latitude, so that putting a = the factor $\frac{\text{Tang. } L}{2\,R''\,P}$ found in Table 8; and b = the factor $\frac{\mu^2}{L\,p^2\,R''^2}$ found in Table 9, and x'' = the last correction.

$$d''L = \mu^2 f^2\, a + A\, b + x''.$$

$d''L$ is evidently to be subtracted from the given latitude L.

EXAMPLE.

The distance of a snowy peak from the meridian of *Belville* is 762,810 feet. The latitude of the intersection of the perpendicular with the meridian is 30° 23′ 39″·5. Required the latitude of the peak?

Here μ = 762,810, and L = 30° 23′ 39″·5.

1st term. Log. of 762,810 = 5·882,421
Log. factor for tang. — 0·000,191

5·882,612

Squared, 1·765,224

A (table number), 0·139,81

80″·358 = 1·905,03

2d term. Log. of A = 1·905
b. (table 6·651

·036″) 8·556

Correction x = ·390″.

Thus we have $dL = 80''\cdot358$
$+ \cdot036$
$+ \cdot390$

$1'\ 20''\cdot8 = 80\cdot781$
$30\ 23\ 39\cdot5$

30 22 18·7 latitude of the peak.

THE 2d term not amounting in this extreme case, to $\cdot1'''$ of a second, may be always neglected, and consequently the calculation reduces itself to the addition of 3 logarithms.

For the longitude we have,

$$\text{Tangent } P = \frac{\text{Tang. } \delta}{\text{Cos } L}$$

BUT tangent $P = \frac{P''}{R''} + \frac{1}{3}\frac{P^3}{R^3} - R''$ being the number of seconds in the arc = to radius.

$$\text{Therefore } \frac{P''}{R''} = \frac{\text{Tang. } \delta}{\text{Cos } L} - \frac{1}{3}\frac{P''^3}{R''^3}$$

$$\text{Multiplying by } R''; \; P'' = R'' \frac{\text{Tang. } \delta}{\text{Cos } L} - \frac{1}{3}\frac{P''^4}{R''^4}$$

AGAIN in like manner tangent $\delta = \frac{\delta''}{R''} f$, f being the factor given by Table 5, or that by which the arc being multiplied the product is the tangent. Also $\delta'' = \frac{\mu}{p}$ p being the number of feet in $1''$ of the perpendicular, substituting these values the above equation becomes,

$$P = \frac{\mu f}{p \text{ Cos } L} - \frac{1}{3}\frac{P''^4}{R''^4}$$

As the second number is so small, we may for P^3 substitute it's approximate value $\frac{\mu^3 f^3}{p^3 \operatorname{Cos}^3 L}$ which will give,

$$P'' = \frac{\mu f}{p \operatorname{Cos} L} + \frac{\mu^3 f^3}{3 R''^2 p^3 \operatorname{Cos}^3 L.}$$

It is evident that the second member is merely the cube of the first divided by $3 R''^2$: although this makes the calculation sufficiently simple, yet I have given a table, (Table 11), from which it may be taken by inspection, the argument being the approximate value of P, or that found by the first part. p Cos L is given in Table 10,

To shew the use of the formula take the last example,

	Log. μ,	5·882,421	
	Log. f,	0·000,191	Table 5.
	p, Cos L, Ar. Co.	8·057,697	Table 10.
	8715·8	5·940,309	
Correction to 8716,	5·2		Table 11.
	Longit. 8710·6 =	2° 25′ 10″·6	true to 2″.

There now remains only the *Asimuth*, and to determine this we have, Tang. $PB : R ::$ sine ABC Cot. PAB, or employing the proper notation, Cot. $L : R ::$ sine δ : Cot. (90° — dz.) = tang. dz.

Tang. dz. $= \frac{\text{Sine } \delta}{\text{Cot. } L}$, and as $\frac{1}{\text{Cot.}} L$ = tangent L this is equivalent to sine tangent L.

by substituting as in the last equation, $\frac{\mu}{R'' p} f$ for sine δ we have,

$$\text{Tang. dz.} = \frac{\mu \text{ Tang. } L}{R'' p} f.$$

ALSO tangent dz. $= \frac{dz''}{R''} + \frac{1}{3} \frac{\delta z''^3}{R''^3}$: putting for this last it's approximate value,

$\frac{\mu^3 \text{ Tang.}^3 L f^3}{p R^3}$ multiplying by R'' and reducing, we have finally,

$dz'' = \frac{\mu \text{ Tang. } L}{p} f - \frac{A^3}{3 R''^2}$ A being the first term. $\frac{\text{Tang. } L}{p}$ is found in Table 12, and the term $\frac{A^3}{3 R^2}$ may be taken at sight from Table 11, the argument being the approximate value of dz''.

FOR an illustration of the formula take the same example,

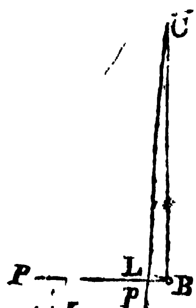
$\mu =$	5·882,421	
Log. f	9·999,904	Table 5.
$\frac{\text{Tang. } L}{p}$	7·761,804	Table 12.
1st term, 4406''·8	3·644,129	
2d ditto, — 0·7		Table 11.
4406. =	1° 13' 26''	

As to the reduction of this result to that in the spherical it must be far below $\frac{1}{2}$ second. For as the angles $A D B$, $A E B$, are the same, and as the angles $P D A$, $P E A$, differ in this extreme case only $\frac{4}{10}$ of a second; it is evident that the inclination of the planes $P D A$, $A D B$ and $A E B$, must also be the same very nearly, or at least within the same limits: and

as *Azimuths* are far from the precision of 3" or 4" it would be a loss of time attending to this correction.

It is thus then that the differences of latitude, longitude and *Azimuth* are found; the calculations are short and symmetrical, and the employment of the several tables are a good assurance against errors accumulating too much. The figure of the earth is fully attended to, and yet the whole operation is shorter, simpler and less liable to oversight, than even the very erroneous, though common method called MERCATOR'S. Having shewn the principles, on which the following results have been obtained, we may now proceed to the details of the calculation.

The latitude of the *Belville* and *Chúr* stations have been stated at 29° 57' 10" and 30° 50' 18", the difference being 53' 8". The *Azimuth* was found to be 3° 25' 05" N. W. It is proposed to determine their distance, regard being had to the figure of the earth.



Let C be the place of the *Chúr* station, and B that of *Belville*, $L\ C$ being the difference of latitude, and $C\ B$ the distance. Draw the perpendicular to the meridian $p\,p\,B$. Put $\delta = C\,B$, $\pi = p\,B$, $\mu = C\,p$, and $p\,L = x$, $\angle\ C\,B\,L =$ *Azimuth* $= Z$.

By spherl. Trig. 1. Tang. δ Cos. $Z =$ tang. π, or δf Cos. $Z = \pi f = \overline{d\,L + x f}$.

Divdg. by Cos. Z.[2] 2. $\delta\ f = \frac{d\,L + x f}{\text{Cos. } Z} = \frac{d\,L f + x f}{\text{Cos. } Z}$.

Article 9. 3. But $x^* = \frac{\mu^2 \text{ Tang. } L}{2\,r}$.

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* f, is neglected here as too small to affect the value of x.

By spherl. Trig. 4. And sine μ = sine δ sine Z, or $\mu f = f\delta$ sine Z.

Therefore $\quad 5.\ \delta f = \frac{d\,L\,f}{\text{Cos. } Z} + \frac{A^2 \text{ sine } 2\,Z\ \text{Tang. } L}{2\,r}$.

r being the radius of the spheroid.

Thus we have $d\,L = 53'\,08'' = 3188''$ Log.	3·503,518
f,	·000,344
feet in 1″ of lat.—30° 23½″ Log. of (Table 1),	2·004,401
Cos. Z 3° 25′ 05″ Ar. Co.	0·000,773
Approximate value δ 322,620	5·509,036
f Ar. Co.	·999,656
A^2,	1·018
Sine $^2 Z$,	7·550
Tang. L,	9·775
2 r Ar. Co.	2·679
+ 10 =	1·024

δ = 322,630 feet.

HAVING thus determined the distance, the next point is to settle the value of the angles. But before entering on this subject, it is necessary to give some short account of the stations, and the several reductions made in the observed angles, to what is termed the centre of the station. 1. The *Chúr* is a mountain which divides the province of *Sirmor* from *Júbal*, elevated nearly 12000 feet above the sea, and covered for a considerable period of the year with snow. It is the highest part of a great ridge or chain of mountains, running for a considerable distance, and easy to be traced. The signal, which was a pyramid 40 feet in height, built of the trunks of

trees, was erected on the crest or edge of the long back that distinguishes the high part of this ridge, and which is properly called the *Chúr*.* On account of the exposed nature of this site, and the tremendous winds that reign on such elevated peaks, it was found that nothing could be satisfactorily executed on such a spot, and therefore most of the observations were made at a place a little below this, where the sudden sinking of the long back, I have described, leaves a hollow tolerably sheltered, as well by its situation, as by the forest which has here its limit. It was from this place that the white lights, which it was necessary to use at *Belville*, were observed, and indeed most of the observations made with the theodolite. This being the case, it was thought necessary to have the distance of this point from the pyramid, accurately determined, and this was done by means of a small triangulation, proceeding from a base of 42 feet carefully measured. The distance was found by two sets of triangles, in all of which the three angles were observed, and the difference of the results is only a few feet: 447 feet may I conceive be taken as the true distance of the station of observation from the pyramid, and with this distance the reductions of the observed angles are calculated.

2. *Belville* (the residence of the Judge and Magistrate), is, as already noticed, the station of *Sahάranpur*. The place where the observations have been made is a pillar of masonry, near a corner of the house, which latter being entirely white, and sufficiently large, forms a very good signal, and is visible at great distances in the mountains. Fig. 1, (Plate IV.) shews

* From चूडा *Chúd'a (Sanscrit)*, a crest. H. H. W.

the position of the pillar, with respect to the house, with the dimensions of the latter, and the directions of the principal stations from it. The reductions are made by measuring the distance of the point to be reduced on a perpendicular, to the direction of the station which has been observed, or from which the observation has been made, and turning the value of this normal into seconds by Table 13.

3. *Bairát* a fort in *Jaunsar*, on the summit of a peak, elevated nearly 7000 feet above the sea, is the third station. It is a quadrangle of loose stones with some slated huts inside. The place of observation is a pillar built by Captain HODGSON within the fort, the position of which is shewn as well as the dimensions of the fort, in fig. 2, (Plate IV). There is an outer wall, one corner of which is sufficiently high to be well defined: it has been sometimes observed, a flag staff being erected to mark the spot. This is also indicated in the figure.

4. *Surkanda* is a high mountain on the border of *Gerhwal*, and the *Dún*. The pyramid which forms the signal is similar to that at the *Chúr*, and is erected over the centre of a small temple with a pointed roof, which had been the point always observed previous to the erection of the signal. The place of observation is a stone pillar built close to a corner of this temple: the direction and dimensions of the latter being all marked in fig. 3, (Plate IV).

FROM the *Chúr* as already noticed the station of *Belville* is not visible, and we were therefore compelled to use white lights.

IN October 1817, I made the following observations with the theodolite, well levelled on a stone pillar.

16th. The light was found to be to the right of the fixed mark,	4° 59' 10"
17th.	25
Mean,	4 59 18
The fort of *Bairát*, (centre) was again found to be left of the mark, ...	47 41 10
Another day, ...	02
a 3d observation, ...	40 35
Mean,	47 40 56
The point observed, is 9 feet from the direction of the pillar,..	— 11
	47 40 45
This angle was found to be by the large circle in June 1818,	47 40 35
Mean,	47 40 40
Belville,	4 59 18
	52 39 58

THE pyramid formed an angle of 131·18 with *Belville*, and consequently 183·58 with *Bairát*. With these angles, the approximate distances

322·600, and the distance of the pyramid 447 feet, we get the reductions to the centre of the station as follows:

Reduction for *Bairát* in *Azimuth*,	+	0 37·5
Belville ditto,	—	3 34·5
Total reduction,	—	4 12
Observed angle,		52 39 58
True angle reduced to centre,		52 35 46

AT *Belville* I found the angle between the *Chúr* pyramid, and *Bairát* fort, as follows:

THE *Azimuth* of the *Chúr* taken by double and single elongations of the pole star, was found by both Captain HODGSON and myself, to be 3° 25′ 05″. This was by a mean of 7 comparisons with the standard mark. The *Azimuth* of *Bairát* centre was in like manner found by two such comparisons to be 28° 03′ 2½″, (for details see observations in December). This gives the *Azimuth* of the pillar, ... 28° 03′ 30″·5.*

Mean, 28° 03′ 30″·5
3 25 05
31 28 35·5

* BY some unsatisfactory observations made before, Captain HODGSON had found it 28° 03′ 00″. On revising the angle however we found it as above.

AT *Bairát*, again, the angle between the *Chúr* pyramid and left corner of *Belville*, as observed by me with the theodolite, was by a mean of great many observations, 95° 56′ 13″. Reduction 21 feet = + 17″

Corrected angle, 95 56·30

CAPTAIN HODGSON observed with his large circle, the angle between the *Chúr* pyramid, and the centre of *Belville* to be, 95° 55′ 17″

Reduction 91 feet, + 01 13

Corrected angle, 95 56 30

These agree well. The three angles are then, *Bairát*,	95°	56′	30″	—17
Belville,	31	28	35·5	—17
Chúr,	52	35	46	—17
Sum,	180	00	51	
Should be,	180	00	10	

Sine Ar. Co., ... 95° 56′ 13″	0·002,336
: 322,630	5·508,705
:: Sine, 52° 35′ 29″	9·899,997
Belville-Bairát, ... 257,655 Feet.	5·411,038
Sine, 31° 28′ 18″	9·717,734
Chúr-Bairát, ... 169,346 Feet.	5·228,775

Calculation of the Latitude of Bairát.

Distance, 257,655	Log. 5·411,038			·411,038
Azimuth, 28° 03′ 30″ } ⅓ Spher. Ex. — 2 }	Cos. 9·945,697	Sine,	28° 03′ 28″	·672,424
Log. π	5·356,735	μ =	121,189	·083,462
Log. of feet in 1″ lat.	2·004,394			
Diff. of lat. 1st part 2250″·8 =	3·352,341			

Log. distance from meridian = Log. μ 5·083 & μ^2 = 0·166

Tab. 8 to

30° 34′ 07″ 0·143

Difference of latitude second part, ... 2·0″ = 0·309

Difference of latitude first part, ...2250″·8

Second ditto, — 2·0

2248·8 = 37′ 28″·8

Latitude of *Belville*, 29 57 10

Latitude of *Bairát*, 30° 34′ 38″·8

POSITION of *Surkanda* on the base, *Belville-Bairát* = 257,655 feet.

AT *Surkanda* I observed the angle between the middle corner of *Bairát* fort and the centre of *Belville*, (vide observations of October), to be as follows:

	° ′ ″
16th	64 47 55
17th	64 48 10
20th	64 48 37·5
21st	64 48 39
24th	64 47 34
26th	64 47 27
Mean,	64 48 04

Reduction to centre,	*Belville* 14 feet,	10 +	in *Azimuth.*
	Bairát 8·6 feet,	14 +	*Ditto.*
		64 48 08	
Reduction to *Bairát* pillar 18 feet,..		29 +	
Belville pillar 98 feet,..		01 11 —	in *Azimuth.*
		64 49 48	

AT *Belville* the angle between the centre of *Bairát* fort and *Surkandā*, pyramid was found, (vide observations for November and December).

	26° 27′ 15″
	16
Mean,	26 27 15·5
Reduction to *Bairát* pillar 40 feet,....	32 —
	26 26 43

AT *Bairát* the angle was observed by me in March 1818. The mean of a great many intersections, gave reduced to the pillar 88° 43′ 39″.

Now we have,

Bairát, ...	88°	43′	39″	— 3
Belville, ...	26	26	43	— 3
Surkanda, ...	64	49	48	— 3
	180	00	10	9
Should be, ...	180	00	08	

Sine of 64° 49′ 45″	0·043,330
: 257,655	5·411,038
:: Sine 88° 43′ 36″	9·999,893
Surkanda-Belville, 284,617	5·454,261
Sine 26° 26′ 40″	9·648,682
126,780	5·103,050

Calculation for the Latitude of Surkanda.

Distance from *Belville,* 284,617

Azimuth, 54° 30′ 16″

Spherical excess, 9

Log. 284,617	5·454,261			·454,261
Cos. 54° 30′ 16″.6	9·763,924	Sine 54° 30′ 16″		·910,709
Log. x =	5·218,185		— 2	5·364,970

Feet in 1" lat. 2·004,388

1636"·1 3·213,797

Diff. lat. 1st part, 27 16·1

Log. μ 0·730

Tab. 8 to 30° 24' = 0·144

7"·5 0·874

27 08·6

29 57 10

30 24 18·6

But we may also calculate the position of *Surkanda* taking as our base, the distance *Belville-Bairát* as deduced from the observed latitudes.

Latitude of *Belville*, ... 29° 57' 10"

Latitude of *Bairát*, ... 30 34 28·5

Azimuth 28° 03' 15. Difference of latitude,... 37 18·5 = 2238"·5

Log. 2238·5 3·349,957

Feet in 1" lat. 2·004,392

Log. factor to tang. 0·000,017

5·354,366

		Cos. Z,	9·945,697
256,240	=	appr. value δ =	5·408,669
		Factor to tang.	— 022

A^2	0·817	The square of the 1st term, or approximate value of δ.
Sine Z,	9·672	
Tang. Z,	9·727	
Tang. L,	9·771	
r Ar. Co.,	2·378	
+ 232 = correction,	2·365	

256,472 *Belville* from *Bairát.*

Sine 64° 49′ 45″	Ar. Co.	0·043,330
256,472		5·409,042
Sine 88° 43′ 36″		9·999,893

Surkanda from *Belville,* 5·452,265 = 283,312 feet.

Calculation of the Latitude.

Log. distance,	5·452,265		5·452,275
Cos. $Z \frac{2}{3}$ S. excess,	9·763,924	Sine $Z - \frac{1}{3}$ S. E.	9·910,709
Log. π	5·216,189	Log. μ	5·362,984
Feet in 1″ lat.	2·004,388		
1628″·6	3·211,811		

	μ^2	0·725
	Tang. *L*,	9·768
	2 *R*'' *A. C.*	4·385
	p^2 Ar. Co.,	5·988
— 7''·3	Correction,	0·866
1621·3 =	27' 01''·3	
	29 57 10	
	30 24 11·3 latitude of *Surkanda.*	

End of the Appendix.

Various Tables useful in expediting Geodesic Calculations; Calculated on an Ellipticity of $\frac{1}{306\cdot157}$ and an Equatorial Degree of 60,640 Fathoms.

TABLE 1.

The length of the Degree and Minute of Latitude in Fathoms with their Logarithms, also the Logarithm of the Radius of Curvature of the Meridian, to every 10' of Latitude.

	Degree of Latitude.		*Logarithms.*	*Diff.*	*Fathoms in 1"*	*Diff.*	*Log. of Fathoms in 1' or ft. in 10"*	*Diff.*	*Log. of Radius of Curvature.*	
30·00	60·607.7	1·5	782,5278	107	1010·128	·025	004,3764	107	540,6504	107
·10	09·2	1·5	5385	107	·153		3871	107	6611	107
·20	10·7	1·5	5492	107	·178		3978	107	6718	107
·30	12·2	1·5	5599	108	·203		4085	108	6825	108
·40	13 7	1 5	5707	108	·228		4193	108	6933	108
·50	15·2	1 5	5815	108	·253		4301	108	7041	108
31 00	16 7	1 5	5923	108	·278		4409	109	7149	109
·10	18·2	1 5	6031	108	·303		4518	109	7258	109
·20	19·7	1·5	6139	109	·328		4627	109	7367	109
·30	21 2	1·5	6248	108	·353		4736	109	7476	109
·40	22 7	1·5	6356	108	.378		4843	109	7585	109
·50	24.2	1 5	6464	109	·493		4954	108	7694	109
32·00	25 8		6573		·430		004,5062		7803	

TABLE 2.

The same for the Perpendicular to the Meridian.

	Perpendicular Degree.		*Logarithms.*	*Diff.*	*Fathoms in 1"*	*Diff.*	*Log. of Fathoms in 1' or ft. in 10".*	*Diff.*	*Log. of Radius of Curvature.*	
30·00	60905·1	·5	784,653,83	359	1015 085	008	0065·0241	371	6542,7764	36
10	905·6	·5	657,42	360	·093		·0612		7800	36
20	906·1	·5	661,02	360	·102		·0983		7836	36
30	906·6	·5	664,62	360	·110		·1354		7872	36
40	907·2	·5	668,22	360	·120		·1725		7908	36
50	907 7	·5	671,82	360	·128		·2796		7944	36
31·00	908·2	·5	675,42	359	·137		·2466	356	7980	36
10	908·7	·5	679,01	359	·145		·2822		8016	36
20	909·2	·5	682,60	359	·153		·3178		8052	36
30	909·7	·5	686,19	359	·162		·3534		8088	36
40	910·2	·5	689,78	359	·170		·3890		8124	36
50	910·7	·5	693,37	360	·178		·4246		8160	36
32 00	911·2	·5	696,97		·187		·4605		8196	

TABLE 3.

Difference of the Meridional and Perpendicular Degrees, multiplied by the square of the sine of the *Azimuth* or $\overline{p - m}$. Sine $^2 A$.

Az.	*Lat.* 30°	*Diff.* 10' *Az.*	*Diff.* 10' *Lat.*	*Lat.* 32°	*Az.*	*Az.*	*Lat.* 30°	*Diff.* 10' *Az.*	*Diff.* 10' *Lat.*	*Lat.* 32°	*Az.*
	FATHOMS.						FATHOMS.				
1	0·1	0 0	0·0	0·1	1	41	128·0	0·9	0 4	122·8	41
2	0·4	0 0	0·0	0·3	2	42	133·1	0.9	0·4	127·7	42
3	0·8	0 1	0 0	0·8	3	43	138·3	0.9	0 5	132·7	43
4	1·4	0·1	0·0	1·4	4	44	143·5	0.9	0·5	137·7	44
5	2·3	0·1	0·0	2·2	5	45	148·7	0.8	0·5	142·7	45
		0 2									
6	3·3	0 2	0·0	3·1	6	46	153·9	0·8	0·5	147·7	46
7	4·4	0 2	0·0	4·3	7	47	159·1	0·8	0·5	152 7	47
8	5·8	0 2	0·0	5·6	8	48	164·3	0·8	0 5	157·6	48
9	7 3	0·3	0 0	7 0	9	49	169·4	0·8	0 6	162·6	49
10	9·0	0·3	0·0	8·6	10	50	174·5	0·8	0·6	167·5	50
11	10·8	0·3	0 0	10·4	11	51	179·6	0·8	0·6	172·4	51
12	12·8	0·4	0·0	12·3	12	52	184·7	0·8	0·6	177·3	52
13	15·0	0·4	0 0	14·4	13	53	189·7	0·8	0·6	182·1	53
14	17·4	0·4	0·1	16·7	14	54	194·7	0·8	0·6	186·8	54
15	19·9	0 4	0·1	19·1	15	55	199·6	0·8	0·7	191·5	55
16	22·6	0·5	0·1	21·7	16	56	204·4	0·8	0·7	196·2	56
17	25·4	0·5	0·1	24·4	17	57	209·2	0·7	0·7	200 8	57
18	28·4	0 5	0·1	27·2	18	58	213·9	0·7	0·7	205·3	58
19	31·5	0·5	0 1	30·2	19	59	218·5	0·7	0.7	209 7	59
20	34·8	0 6	0·1	33·4	20	60	223 0	0·7	0.7	214·1	60
21	38·2	0 6	0·1	36·6	21	61	227·5	0·7	0.8	218·4	61
22	41·7	0 6	0·1	40·0	22	62	231·9	0·7	0·8	222·6	62
23	45·4	0·6	0·2	43·5	23	63	236·1	0·7	0·8	226 6	63
24	49·2	0 7	0·2	47·2	24	64	240·3	0 6	0·8	230·6	64
25	53·1	0 7	0·2	50·9	25	65	244·3	0·6	0·8	234·4	65
26	57·1	0.7	0·2	54·8	26	66	248·2	0·6	0·8	238·2	66
27	61·3	0.7	0·2	58 8	27	67	252·0	0·6	0·8	241·9	67
28	65·5	0.7	0 2	62·8	28	68	255·7	0·6	0·8	245·4	68
29	69·0	0.7	0 2	67·0	29	69	259·2	0·5	0·9	248·8	69
30	74·4	0 7	0 2	71·3	30	70	262·6	0·5	0·9	252·0	70
31	78 9	0.8	0·3	75·7	31	71	265 9	0·5	0·9	255·2	71
32	83·5	0·8	0·3	80·1	32	72	269·0	0·5	0·9	258·2	72
33	88·2	0 8	0·3	84·6	33	73	272·0	0·4	0 9	261 0	73
34	93·0	0·8	0·3	89·2	34	74	274·8	0·4	0·9	263·7	74
35	97·8	0·8	0·3	93·9	35	75	277·5	0·4	0·9	266·3	75
36	102·7	0·8	0·3	98 5	36	76	280·0	0·4	0·9	268·7	76
37	107·7	0·8	0·4	103·3	37	77	282·4	0·3	0·9	271·0	77
38	112·7	0 8	0 4	108·1	38	78	284·6	0·3	1·0	273·1	78
39	117·8	0 8	0·4	113 0	39	79	286 6	0·3	1·0	275·0	79
40	122 9	0 8	0·4	117 9	40	80	288·4	0 3	1·0	276·8	80

TABLE 3,—Continued.

Az.	Lat. 30°	Diff. 10' Az.	Diff. 10' Lat.	Lat. 32°	Az.	Az.	Lat. 30°	Diff. 10' Az.	Diff. 10' Lat.	Lat. 32°	Az.
	FATHOMS.						FATHOMS.				
81	290·1	0·2	1·0	278·4	81	86	296·0	0·1	1·0	284·0	86
82	291·6	0·2	1·0	279·8	82	87	296·6	0·1	1·0	284·6	87
83	293·0	0·2	1·0	281·1	83	88	297·0	0·0	1·0	285·0	88
84	294·1	0·2	1·0	282·3	84	89	297·3	0·0	1·0	285·3	89
85	295·1	0·1	1·0	283·2	85	90	297·4	0·0	1·0	285·4	90

TABLE 4.

Spherical Excess.

Adjacent Angle.	100,000 Feet.	Diff.	Logarithm.	Diff.	Adjacent Angle.	100.000 Feet.	Diff.	Logarithm.	Diff.
° °	"				° °	"			
1 89	·041	42	8·6155	3008	21 69	·791	31	·8982	174
2 88	·083	40	·9163	1756	22 68	·821	30	·9145	163
3 87	·123	42	9·0919	1213	23 67	·850	29	·9296	151
4 86	·165	40	·2162	962	24 66	·879	29	·9438	142
5 85	·205	40	·3124	782	25 65	·906	27	·9570	132
							26		122
6 84	·245	41	·3906	658	26 64	·932	25	·9692	115
7 83	·286	40	·4564	566	27 63	·957	23	·9807	106
8 82	·326	39	·5130	497	28 62	·980	22	·9913	98
9 81	·365	39	·5627	440	29 61	1·002	21	0·0011	91
10 80	·404	39	·6067	396	30 60	1·023	20	0 0102	84
11 79	·443	38	·6463	357	31 59	1·043	20	0·0186	78
12 78	·481	37	·6820	325	32 58	1·063	18	0·0264	70
13 77	·518	37	·7145	298	33 57	1·081	15	0 0334	63
14 76	·555	36	·7443	274	34 56	1·096	15	0 0397	60
15 75	·591	35	·7717	252	35 55	1·111	13	0·0457	52
16 74	·626	35	.7969	234	36 54	1·124	12	0 0509	46
17 73	·661	34	.8203	216	37 53	1·136	11	0 0555	41
18 72	·695	33	.8419	201	38 52	1·147	9	0.0596	35
19 71	·728	32	.8620	188	39 51	1·156	8	0 0631	29
20 70	·760	31	.8808	174	40 50	1·164	6	0.0660	25

TABLE 4,—Continued.

Adjacent Angle.	*100,000 Feet.*	*Diff.*	*Logarithm.*	*Diff*
° °				
41 49	1·170	6	0·0685	25
42 48	1·175	5	0 0703	18
43 47	1·179	4	0 0716	13
44 46	1·181	2	0 0724	8
45 45	1·182	1	0 0727	3

Multiples of the preceding.

Multiplier.	*Length of the given Side.*	*Difference.*
1	100,000	
2	141,421	41,421
3	173,205	31,784
4	200,000	26,795
5	223,607	23,607
6	244,949	21,342
7	264,575	19,626
8	282,843	18,268
9	300,000	17,157
10	316,228	16,228
11	331,662	15,434
12	346,410	14,748
13	360,555	14,145
14	374.166	13,611
15	387,298	13,132
16	400,000	12,702
17	412,310	12,310
18	424,264	11,954
19	435,890	11,626
20	447,214	11,324
21	458,258	11,044
22	469.041	10,783
23	479,583	10,542
24	489,898	19.315
25	500,000	10,102
26	509,902	9,902
27	519,615	9,713
28	529,150	9,535
29	538,516	9·366
30	547,722	9 206
31	556,776	9 054
32	565,685	8 909
33	574,456	8·771
34	583,095	8·639
35	591,608	8·513
36	600.000	8·392
37	608,276	8·276
38	616,441	8 165
39	624.500	8·059
40	632,455	7·955
41	640,312	7·857
42	648.074	7·762
43	655,744	7·670
44	663,325	7·581
45	670,820	7·495
46	678,233	7·413
47	685,565	7·332
48	692,820	7·255
49	700,000	7·180
50	707,107	7·107
51	714,143	7·036
52	721,110	6·967
53	728,011	6·901
54	734,847	6·836
55	741,620	6·773
56	748,331	6·711
57	754,983	6·652
58	761,577	6·594
59	768,115	6·538
60	774,597	6·482
61	781.025	6·428
62	787,401	6·376
63	793,725	6·324
64	800,000	6·275
65		

TABLE 5.

Of the Difference, of the Logarithms, of the Arc and Tangent, to six places of Figures, with the length of the Arc in Feet, both on the Meridian and Perpendicular; and the Logarithms of the several Arcs in Seconds and Feet.

Arc.	*Logarithms of* "	Diff.	*Feet on the Meridian.*	*Logarithm.*	*Feet on the Perpendicular*	*Logarithm.*	*Diff. Arc & Tang.*	*Diff.*
° ′								
0 04	2·3802		24,244	4·3846	24,361	4·3867	0	1
08	2·6812		48,480	4·6856	48,720	4·6877	1	1
12	2·8573		72,730	4·8617	73,080	4·8638	2	1
16	2·9823		97,000	4·9867	97,460	4·9888	3	2
20	3·0792		121,230	5·0836	121,820	5·0857	5	2
24	3·1584		145,480	5·1628	146,180	5·1649	7	3
28	3·2253		169,710	5·2297	170,530	5·2318	10	2
32	3·2833		193,960	5·2877	194,900	5·2898	12	4
36	3·3344		218,170	5·3388	219,230	5·3409	16	4
40	3·3802		242,440	5·3846	243,620	5·3867	20	2
42	3·4014		254,570	5·4058	255,800	5·4079	22	2
44	3·4216		266,600	5·4260	268,000	5·4281	24	2
46	3·4409		278,810	5·4453	280,200	5·4474	26	2
48	3·4594		290,900	5·4638	292,350	5·4659	28	3
50	3·4771		303,020	5·4815	304,510	5·4836	31	2
52	3·4941		315,210	5·4986	316,740	5·5007	33	3
54	3·5105		327,270	5·5149	328,860	5·5170	36	2
56	3·5263		339,400	5·5307	341,010	5·5328	38	3
58	3·5416		351,570	5·5460	353,270	5·5481	41	3
1 00	3·5563		363,670	5·5607	365,430	5·5628	44	3
02	3·5705		375,760	5·5749	377,580	5·5770	47	3
04	3·5843		387,890	5·5887	389,770	5·5908	50	3
06	3·5977		400,100	5·6021	401,970	5·6042	53	4
08	3·6107		412,200	5·6151	414,200	5·6172	57	3
10	3·6232		424,230	5·6276	426,300	5·6297	60	3
12	3·6355		436,420	5·6399	438,540	5·6420	63	4
14	3·6474		448,540	5·6518	450,720	5·6539	67	4
16	3·6589		460,700	5·6634	462,920	5·6655	71	3
18	3·6702		472,720	5·6746	475,010	5·6767	74	4
20	3·6812		484,850	5·6856	487,200	5·6877	78	4
22	3·6919		497,050	5·6964	499,460	5·6985	82	4
24	3·7024		509,100	5·7068	511,700	5·7090	86	5
26	3·7126		521,200	5·7170	523,700	5·7191	91	4
28	3·7226		533,400	5·7270	535,900	5·7291	95	4
30	3·7324		545,500	5·7368	548,100	5·7389	99	5

TABLE 5,—Continued.

Arc. ° '	Logarithms of "	Diff.	Feet on the Meridian.	Logarithm.	Feet on the Perpendicular	Logarithm.	Diff Arc & Tang	Diff
1 32	3·7419		557,600	5·7463	560,300	5·7484	104	4
34	3·7513		569,800	5·7557	572,500	5·7578	108	5
36	3·7604		581,900	5·7648	584,600	5·7669	113	5
38	3·7694		594,100	5·7738	596,900	5·7759	118	4
40	3·7781		606,100	5·7825	609,000	5·7846	122	5
42	3·7867		618,200	5·7911	621,100	5·7932	127	5
44	3·7952		630,400	5·7996	633,400	5·8017	132	6
46	3·8034		642,400	5·8078	645,500	5·8099	138	5
48	3·8116		654,700	5·8160	657,800	5·8181	143	5
50	3·8195		666,600	5·8239	669,900	5·8260	148	6
52	3·8274		678,900	5·8318	682,200	5·8339	154	5
54	3·8350		690,900	5·8394	694,200	5·8415	159	6
56	3·8426		703,100	5·8470	706,500	5·8491	165	6
58	3·8500		715,200	5·8544	718,600	5.8565	171	5
2 00	3·8573		727,300	5·8617	730,800	5·8638	176	3
01	3·8609		733,300	5·8653	736,900	5·8674	179	3
02	3·8645		739,400	5·8689	743,100	5·8710	182	3
03	3·8680		745,400	5·8724	749,040	5·8745	185	3
04	3·8716		751,700	5·8760	755,300	5·8781	188	3
05	3·8751		757,700	5·8795	761,400	5·8816	191	3
06	3·8785		763,700	5·8829	767,400	5·8850	194	4
07	3·8819		769,900	5·8864	773,600	5·8885	198	3
08	3·8853		775,900	5·8898	779,600	5·8919	201	2
09	3·8887		781,800	5·8931	785,600	5·8952	203	4
10	3·8921		787,900	5·8965	791,800	5·8986	207	3
11	3·8954		794,000	5·8998	797,800	5·9019	210	3
12	3·8987		800,000	5·9031	803,900	5·9052	213	4
13	3·9020		806,100	5·9064	810,000	5·9085	217	3
14	3·9052		812,300	5·9097	816,300	5·9118	220	3
15	3·9085		818,300	5·9129	822,300	5·9150	223	4
16	3·9117		824,300	5·9161	828,300	5·9182	227	3
17	3·9149		830,400	5·9193	834,400	5·9214	230	3
18	3·9180		836,400	5·9224	840,400	5·9245	233	4
19	3·9212						237	3
20	3·9243						240	

TABLE 6.

Of the distance in Feet between the points of intersection of the Verticals, with the Polar Axis, for a given difference of Latitude.

	Difference of Latitude.												
Lat.	10"	20"	30"	40"	50"	60"	70"	80"	90"	100"	110"	120"	130"
30°	5·6	11·2	16·7	22·3	27·9	33·5	39·1	44·6	50·2	55·8	61·4	67·0	72·5
32	5·5	10·9	16·4	21·9	27·4	32·8	38·3	43·8	49·2	54·7	60·2	65·6	71·1

TABLE 7.

Of the Spheroidal Correction of Latitude.

Argument, Difference of Latitude.												
10"	20"	30"	40"	50"	60"	70"	80"	90"	100"	110"	120"	130"
·0"	·1"	·1"	·2"	·2"	·3"	·3"	·4"	·4"	·5"	·5"	·6"	·6"

TABLE 8.

Of the Factor for difference of Latitude, of the ends of a Perpendicular.

Latitude.	*Logarithm of Factor.*	*Latitude.*	*Logarithm of Factor.*	*Latitude.*	*Logarithm of Factor.*	*Latitude.*	*Logarithm of Factor.*
30°00'	0·1330	30°32'	0·1423	31°02'	0·1509	31°32'	0·1594
·02	·1336	·34	·1429	·04	·1515	·34	·1600
·04	·1342	·36	·1434	·06	·1520	·36	·1606
·06	·1347	·38	·1440	·08	·1526	·38	·1611
·08	·1353	·40	·1446	·10	·1531	·40	·1617
·10	·1359						
		30·42	·1452	31·12	·1537	31·42	·1622
30·12	·1365	·44	·1457	·14	·1543	·44	·1628
·14	·1371	·46	·1463	·16	·1549	·46	·1634
·16	·1376	·48	·1469	·18	·1554	·48	·1639
·18	·1382	·50	·1474	·20	·1560	·50	·1645
·20	·1388						
		30·52	·1480	31·22	·1566	·52	·1650
30·22	·1394	·54	·1486	·24	·1572	·54	·1656
·24	·1440	·56	·1492	·26	·1577	·56	·1662
·26	·1405	·58	·1497	·28	·1583	·58	·1667
·28	·1411	31·00	·1503	·30	·1588	32·00	·1672
·30	·1417						

TABLE 9.

Of the Factor $\frac{\mu^2}{L\,p'}\,R'''$

Argument, value of μ in Feet.								
	Feet. 100000	Feet. 200000	Feet. 300000	Feet. 400000	Feet. 500000	Feet. 600000	Feet. 700000	Feet. 800000
Log. of Factor.	4·760	5·362	5·714	5·964	6·158	6·316	6·450	6·566

TABLE 10.

Of the number of Feet in 1″ of Longitude with the Logarithms.

Lat.	Feet in 1″	Logarithm.	Lat.	Feet in 1″	Logarithm.	Lat.	Feet in 1″	Logarithm.
° ′	Feet.		° ′	Feet.		° ′	Feet	
30.00	87·91	1·944,033	30·25	87·54	1·942,202	30·50	87·17	1·940,344
·01	·89	·943,960	·26	·52	·942,128	·51	·15	·940,269
·02	·88	·943,887	·27	·51	·942,054	·52	·14	·940,194
·03	·86	·943,815	·28	·50	·941,980	·53	·12	·940,118
·04	·85	·943,742	·29	·49	·941,906	·54	·11	·940,043
·05	·84	·943,669	·30	·47	·941,833	·55	·09	·939,968
·06	·82	·943,596	·31	·45	·941,759	·56	·07	·939,892
·07	·81	·943,523	·32	·44	·941,685	·57	·06	·939.817
·08	·79	·943,450	·33	·42	·941,610	·58	·05	·939,742
·09	·78	.943,377	·34	·41	·941,536	·59	·03	·939,667
·10	·76	·943.305	·35	·39	·941,462	31·00	·02	·939,592
·11	·75	·943,232	·36	·38	·941,388	·01	·00	·939,516
·12	·73	·943,159	·37	·36	·941,313	·02	86·98	·939,440
·13	·72	·943,086	·38	·35	·941,239	·03	·97	·939,364
·14	·70	·943,013	·39	·33	·941,165	·04	·95	·939,288
·15	·69	·942,940	·40	·32	·941,091	·05	·94	·939,212
·16	·67	·942,867	·41	·31	·941,016	·06	·92	·939.136
·17	·66	·942,794	·42	·29	·940,941	·07	·91	·939,060
·18	·64	·942,720	·43	·27	·940.867	·08	·89	·938,984
·19	·63	·942,647	·44	·26	·940,792	·09	·88	·938,908
·20	·61	·942,572	·45	·24	·940,717	·10	·86	·938,832
·21	·60	·942,498	·46	·23	·940,643	·11	·85	·938.756
·22	·58	·942,424	·47	·21	·940,568	·12	·83	·938,680
·23	·57	·942,350	·48	·20	·940,493	·13	·82	·938,603
·24	·55	·942,276	·49	·18	·940,418	·14	·80	·938,527

TABLE 10.—Continued.

Latitude.	Feet in 1′	Logarithm.	Latitude.	Feet in 1″	Logarithm.	Latitude.	Feet in 1″	Logarithm.
° ′			° ′			° ′		
31·15	86·79	1·938,451	31·30	86.56	1·937.301	31·45	86·33	1·936,139
·16	·77	·938,374	·31	·54	·937,224	·46	·31	·936,061
·17	·75	·938,298	·32	·53	·937,147	·47	·29	·935,983
·18	·74	·938,222	·33	·51	·937,069	·48	·28	·935,905
·19	·73	·938,145	·34	·50	·936,992	·49	·26	·935,827
·20	·71	·938,069	·35	·48	·936,915	·50	·25	·935,749
·21	·70	·937,992	·36	·46	·936,838	·51	·23	·935,671
·22	·68	·937,915	·37	·45	·936,760	·52	·22	·935,592
·23	·66	·937,839	·38	·43	·936,683	·53	·20	·935,514
·24	·65	·937,762	·39	·42	·936,606	·54	·19	·935,436
·25	·63	·937,685	·40	·40	·936,528	·55	·17	·935,357
·26	·62	·937,608	·41	·39	·936,450	·56	·16	·935,279
·27	·60	·937.532	·42	·37	·936,373	·57	·14	·935,201
·28	·59	·937,455	·43	·36	·936,295	·58	·12	·935,122
·29	·57	·937,378	·44	·34	·936,217	·59	·11	·935,044

TABLE 11.

Of the Correction of the Longitude found by the preceding.

Approximate Longitude	Correction.	Approximate Longitude	Correction.	Approximate Longitude	Correction.	Approximate Longitude	Correction.	Approximate Longitude	Correction.
1800″	0·0″	4200″	0·6″	5700″	1·4″	6480″	2·1″	7080″	2·8″
2400	0·1	4500	0·7	6000	1·7	6600	2·2	7000	2·9
3000	0·2	4800	0·9	6120	1·8	6720	2·4	7320	3·1
3600	0·4	5100	1·0	6240	1·9	6840	2·5	7410	3·2
3900	0·5	5400	1·2	6360	2·0	6960	2·6	7560	3·4

TABLE 12.

Of the Factor (Logarithmic) for finding differences of *Azimuth.*

Latitude.	Logarithm	Latitude.	Logarithm.	Latitude.	Logarithm.	Latitude.	Logarithm.
° ′		° ′		° ′		° ′	
30·00	7·7549	30·05	7·7564	30·10	7·7578	30·15	7·7593
·01	·7552	·06	·7567	·11	·7581	·16	·7596
·02	·7555	·07	·7570	·12	·7584	·17	·7599
·03	·7558	·08	·7573	·13	·7587	·18	·7602
·04	·7561	·09	·7575	·14	·7590	·19	·7605

TABLE 12,—Continued.

Latitude.	*Logarithm.*	*Latitude.*	*Logarithm.*	*Latitude.*	*Logarithm.*	*Latitude.*	*Logarithm.*
° ′		° ′		° ′		° ′	
30·20	7·7607	30·45	7·7680	31·10	7.7751	31·35	7·7822
·21	·7610	·46	·7683	·11	·7754	·36	·7825
·22	·7613	·47	·7686	·12	·7757	·37	·7828
·23	·7616	·48	·7688	·13	·7760	·38	·7831
·24	·7619	·49	·7691	·14	·7763	·39	·7833
·25	·7622	30·50	·7694	·15	·7766	·40	·7836
·26	·7625	.51	·7697	·16	·7768	·41	·7839
·27	·7628	·52	·7700	·17	·7771	·42	·7842
.28	·7631	·53	·7703	·18	·7773	·43	·7845
·29	·7634	·54	·7705	·19	·7777	·44	·7848
·30	·7636	·55	·7708	·20	·7780	·45	·7850
·31	·7639	·56	·7711	·21	·7782	·46	·7853
·32	·7642	·57	·7714	·22	·7785	·47	·7856
·33	·7645	·58	·7717	·23	·7788	·48	·7859
·34	·7648	·59	·7720	·24	·7791	·49	·7862
·35	·7651	31·00	·7723	·25	·7794	·50	·7864
·36	·7654	·01	·7726	·26	·7796	·51	·7867
·37	·7657	·02	·7728	·27	·7799	·52	·7870
·38	·7660	·03	·7731	·28	·7802	·53	·7873
·39	·7662	·04	·7734	·29	·7805	·54	·7876
·40	·7665	·05	·7737	·30	·7808	·55	·7878
.41	·7668	·06	·7740	·31	·7811	·56	·7881
.42	·7671	·07	·7743	·32	·7814	·57	·7884
·43	·7674	·08	·7746	·33	·7816	·58	·7887
.44	·7677	·09	·7748	·34	·7819	·59	·7890

Use of the preceeding Tables.

TABLE 1.

THIS contains the length of the degree in fathoms with the logarithms, also of the minute and its logarithm. As the number of feet in 1″ is the same with the number of fathoms in 1′, divided by 10, it is evident the logarithm will be the same, with the exception of the index, which must be one less. For turning feet into seconds, the logarithms in column 7 may be used.

TABLE 2.

REQUIRES no explanation, being the same as the preceding.

TABLE 3.

Is the difference of the meridional and perpendicular degrees, multiplied by the square of the sine of the *Azimuth* or $(p - m)$. Sine $^2 A$. These numbers are useful in finding readily the value of the oblique degree, sometimes required to reduce arcs in feet to the angle formed by the verticals. HUTTON's expression taken from the 2d vol. Trig. survey is for the oblique degree

$\frac{p\,m}{d=p + (m - p)\,\text{Sine}\,^2 a.}$ a being the *Azimuth*, and p m the perpendicular, and meridional degrees. This being expanded into series is equal to

$$m + \frac{x\,m}{p} + \frac{x^2 m}{p} + \frac{x^3 m}{p} \text{ \&c. being} = (p - m).\ \text{Sine}\,^2 a.$$

Now as the correction is small and m p are nearly equal, and extreme accuracy not required in the case in question, we may take the above as equal to, for practical purposes,

$$m + (p - m)\,\text{Sine}\,^2 A.$$

THE table gives the correction $(p - m)$ Sine $^2 A$, which is to be added to the degree of latitude, in order to have the oblique degree.

TABLE 4.

Is the spherical excess, that is the sum above 180°, which the three angles of a small spherical triangle amount to.

THE arguments are the two sides and adjacent angles.

EXAMPLE.

GIVEN a triangle having two of its sides = 227,000 and 300,000 feet, and its angles (adjacent to the two sides) 52° and 36°. Required the excess of the three angles above 180°?

Table No. to 52°	= 1″·147		to 36° =	·772″
Multiplier to side 227,000	5·2		300,000	9
	5·735			6·948
	2·294			
1st part,	5·96			
2d part,	6·95			
	12·9	= spherical excess.		

As the two angles are acute, both parts of the spherical excess are positive, but if one of the angles be obtuse the part answering to it will be negative. When the angle is not to be found in the table, it's supplement is to be taken.

TABLE 5.

THE difference of the logarithms of the arc and tangent, for probable distances within the survey. It also serves to find the sines.

EXAMPLE.

WHAT is the tangent to the arc measuring 345,000 feet in length expressed in feet. Also find it's sine. The distance being taken in the direction of the meridian.

		For the Tangent.		For the Sine.
Log.	345,000	5·537,819		5·537,819
Table No.		0·+000,039		—·000,020 = ½ Tab. No.
Log. tangent,		5·537,858	Log. sine,	·537,799

THE seconds and their logarithms, also the logarithm of the arcs in feet being given, render the table, much more convenient in use.

TABLE 6.

THIS table requires no explanation.

TABLE 7.

CONTAINS the spheroidal correction of latitude, it's use is evident.

TABLE 8.

CONTAINS the logarithmic factor, for finding the difference of latitude of the two ends of a perpendicular arc.

EXAMPLE.

GIVEN the length of an arc perpendicular to the meridian = 400,000 feet, and the latitude of one end $30^{\circ}\ 53'\ 00''$. Required the latitude of the other end?

Log. of 400,000		5·6020
Squared,		1·2040
Log. from table $30^{\circ}\ 53'$		0·1483
$22''·5$	=	1·3523
30 53 00		
30 52 37·5	Latitude required.	

THE results found from this table may be corrected by applying the numbers from the preceeding, although it may admit of doubt if in a survey of this description, any quantity much below 1 be worth regarding.

TABLE 9.

CONTAINS the logarithmic factor for correcting the preceding result, though the operation of this correction be far too feeble to deserve being attended to. It is less than that given in Table 7. The logarithm in the table is to be added to the logarithm of the correction found by the preceding, the sum is the logarithm of the correction. It may be however always neglected, and I have only given the table to shew how safely.

TABLE 10.

CONTAINS the factor natural and logarithmic for reducing distances on the perpendicular in feet, to their corresponding differences of longitude.

EXAMPLE.

GIVEN the length of an arc perpendicular to the meridian = 400,000 feet. Required the difference of longitude of its two extremities?

Log. of 400,000	5·602,060
Factor to 30° 23′	1·942,350
4567″·9	= 3·659·710

Is the difference of longitude required, but it must be corrected by.

TABLE 11.

Thus, approximate longitude,...	4567·9
Correction to,...........	—·7
True difference,.........	4567·2

TABLE 12.

CONTAINS the logarithmic factor, for finding the difference of *Azimuth* of the two ends of a perpendicular arc.

EXAMPLE.

LET the length of a perpendicular to the meridian be 375,000 feet, and the latitude of the right angle 31° 07′. Required the difference of *Azimuth* of its two extremities?

Log. of 375,000	5·5740
Factor to 31° 07′	7·7743
Difference of *Azimuth* required 22″·30 =	3·3483

IF this difference were greater it might be necessary to correct it by Table 11, as in the case of the longitude, but unless the correction amounted to a few seconds it is hardly worth attending to, particularly as *Azimuths* are not easy to be observed with great precision.

IT is to be noted, that though these two tables give the correct difference of *Azimuth* of the two ends of the perpendicular, yet that this is not always the difference answering to the two ends of the corresponding oblique arc, because it is evident, that where the arcs are large there will be a considerable spherical excess, and this must be taken into consideration always.

DETAIL OF THE MEASUREMENT OF A BASE, EXECUTED WITH PINE RODS, IN THE DEHRA DUN.

February, 1819.

DATE.	No. of Hypothenuse.	Sets of Rods 100 Feet each.	COMPARATOR. Index.	COMPARATOR. Thermometer.	COMPARATOR. Reduced.	THE RODS. 1·2	THE RODS. 2·3	THE RODS. 3·4	THE RODS. 4·5	THE RODS. 4·5	Inclination of the Hypothenuse.	Reduction to Horizon.	Plummet.	Above.	Ascents.	Below.	Descents.	REMARKS.
			°			Languette.	Nonius.	Languette.	Old N.	New N.	° ′ ″	Feet.	Inches.	Feet.				
1819; Feb. 3	1	1½	2 43+	66·6	1025	....	....	18 3·9	0·748	....	0 40 10 E.	·0103	— 2·60	2·5	1·8			The easurement commenced 2 6 inches, behind the point marking the extremity of the base.
			2 41	65·4	1017	10 2·5	0·780	....	....	....								
4			0 14	45 7	1052	....	....	5 7·9	0·710	....								
	2	1	1 07	59·2	1090	6 7·0	2·243	....	....	....	1 40 05 E.	·0425			2·9			
			1 12	61·1	1115	....	....	8 4·8	0·550	....								
	3	2½	1 52	67·7	1108	5 13·2	1·148	....	....	....	0 09 00 E.	·0008			0·6			
			2 30	72 0	1098	....	....	9 2·2	0·675	....								
			2 47	75·8	1107	13 21·3	0·715	....	....	....								
			3 43	84·0	1102	....	....	8 4·0	0·695	....								
			3 30	77·0	1055	18 1·3	0·830	....	....	....								The 3 rod falls short of picket No. 1, by 1·02 feet exactly.
	4	1½	2 51	81·8	1162	....	....	10 5·7	0·500	....	1 19 13 E.	·0400			3·5			
			2 37	76·3	1130	10 12·8	0·850	....	....	....								
			2 21	71·5	1107	....	....	11 6·5	0·728	....								
	5	1	1 38	64 6	1107	13 8·0	0·740	....	....	....	0 28 35 E.	·0035			0·8			This ypothenuse concluded the day's work—The plummet and tripod were set to mark the 4·5 rod $\frac{1}{24}$ inch in adauce. In the morning found correct.
			1 18	56·1	1052	....	....	5 2·1	0·590	....			+ 0·02					
5	6	7½	2 18	87·0	1264	10 2·6	0·658	....	....	....	0 24 00 E.	·0183			5·2			
			....	..	1264	....	....	12 5·3	0·720	....								A new nonius was fitted on to the 4·5 rod, it marked here 0·315.
			2 12	77·5	1181	7 9·0	0·828	....	....	....								
			2 17	79 0	1188	....	....	9 7·9	0·740	....								The ew nonius marked ·330, after this the old one was not observed.
			2 12	74·0	1147	15 0·3	0·663	....	....	....								The 3 rod overshot the 2d pin by 1·32 feet exactly.
			2 09	72 0	1132	....	....	14 1·0	....	0·298								Here he new nonius was observed.
			2 04	72·5	1143	4 12·5	0·888	....	....	....								
			1 53	68.6	1122	....	....	4 0·9	....	0·315								
			1 45	66·2	1111	12 12·7	0·650	....	....	....								
			1 35	62·7	1093	....	....	9 2·7	....	0·285								
			1 04—	45·4	1172	7 15·4	0·713	....	....	....								Set t tripod to mark the point between the 4·5 and 1·2 rods. It was ·04 inch in advance of the 4·5 rod, which later in the morning was found to have expanded 0 2 inch. The mean of the evening and morning is given.
6			0 57	48·9	1198	....	....	10 7·0	....	0·320								
			0 38	52·8	1205	21 3·5	0·948	....	....	....								
			0 19	58·4	1229	....	....	15 6·0	....	0·298								
			0 08+	62 0	1221	8 10·2	0 675	....	....	....								The d of the 2·3 rod overshot the 3d picket 11·7 inches.
	7	4	2 17	74·6	1143	11 6·3	0·678	....	....	....	0 33 10 E.	·0186	—14·70	0·8	3·9			This ypothenuse was commenced from the 3d picket 250 feet, having been vitiated by a mistake.
			2 09+	72·4	1136	....	....	10 0·2	....	0·308								
			2 15	72 7	1129	7 14·4	1·025	....	....	....								
			2 03	69 7	1116	....	....	12 4·0	....	0·328								
			1 53	66·3	1099	10 3·0	0·858	....	....	....								
			1 48	64 3	1088	....	....	6 3·5	....	0.255								
			1 38	62 4	1085	10 2·3	0·758	....	....	....								
			1 17	56·4	1059	....	....	12 0·0	....	0·315								Set t od to $\frac{1}{12}$ inch in advance of the 4·5 rod. Surrounded it with a chain of stands, and posted a sentry. Commence on he 8th, by pushingout the languette to meet the wire, resumed the former nonius. The new one marked he 0·310.
8	8	2	2 35	70 2	1073	0 21·2	0·758	...	....	....	1 01 35 E.	·0320	+ 0·08		3·6	1·5		
			2 23	65.8	1048	....	....	11 4·6	0·728	....								
			2 12	61·3	1022	9 03·2	1·093	....	....	....								
			1 48	55 5	1001	....	....	15 01·3	0·570	...								New onius marked 0·240. Set the tripod in advance of the 4·5 rod, 0·298 inches.
9	9	4	2 37	72 5	1083	12 18·3	0·755	....	....	....	0 25 0 E.	·0106	+ 0·30		2·9			Com ence by pushingout the langnette to meet the wire of the plummet, marking the point on the tripod.
			2 39	71·6	1081	....	....	8 8·9	0·633	....								New onius 0 263.
			2 43	70 3	1061	22 1·3	0·700	....	....	....								
			2 48	72 2	1073	....	....	10 1·3	0·725	....								New nonius 0·315.
			2 42	72·2	1082	11 13 8	1·020	....	....	....								
			2 48	69 9	1051	....	....	10 8·2	0 720	....								New nonius 0·308.
			2 41	71·0	1071	6 16·5	0·710	....	....	....								
			2 33	71·0	1083	....	....	4 2·5	0·670	....								New nonius 0 295.
	10	6	2 39	71·1	1076	4 16·0	0·695	....	....	....	0 40 55 E.	·0425			7·1			
			2 40	72 0	1083	....	....	10 0·0	0·740	....								New nonius 0·319.
			2 37	65 4	1023	8 10·0	0·695	....	....	....								
			2 37	62 3	993	....	....	8 5·5	0·595	....								New nonius 0·250.
			2 05	57·3	991	[illegible] 17·3	0·788	....	....	....								
			1 41	54·0	998	....	....	[illegible] 4·7	[illegible]	....								New nonius 0 313.
			1 28	52·0	998	7 [illegible]	[illegible]	....	....	....								Set tr od in advance of the 2·3 rod 0·1 inch.
10			....	..	1117	8 5·5	0·700	....	....	....			+ 0·10					Commenced by pushingout the languette to touch the wire, marking the point the tripod.
			0 31	55·1	1117	....	....	5 6·0	0·755	....								
			1 10	55·0	1055	6 3·0	0·963	....	....	....								
			1 38	66 0	1120	....	....	7 4·9	0·710	....								
			2 11	65·0	1059	7 12·7	0·698	....	....	....								
	11	5	2 12	67·0	1078	....	....	6 3·7	0·680	....	0 58 10 E.	·0716			8·5			
			2 13	68 0	1086	13 21·5	1·140	....	....	....								
		36			70,388	313 321·9	28·058	287 129·2	14·892	2·722		·2907	—13·80	3·3	40 8	1·5		

VII.

On the ancient Geography of India.

By Lieut. Col. F. WILFORD.

INTRODUCTORY REMARKS.

A FEW years after my arrival in *India*, I began to study the ancient history, and geography of that country; and of course, endeavoured to procure some regular works on the subject: the attempt proved vain, though I spared neither trouble, nor money, and I had given up every hope, when, most unexpectedly, and through mere chance, several geographical tracts in *Sanscrit*, fell into my hands. I very much regret, that they did not make their appearance somewhat earlier; for time passes away heedless of our favourite pursuits.

In some of the *Puráńas*, there is a section called the *Bhuvana-cośa*, a magazine, or collection of mansions: but these are entirely mythological, and beneath our notice. Besides those in the *Puráńas*, there are other geographical tracts, to several of which is given the title of *Cshétra-samása*, or collection of countries; one is entirely mythological, and is highly esteemed by the *Jainas*; another in my possession, is entirely geographical, and is a most valuable work. There is also the *Trai-locya-derpana*, or

mirror of the three worlds: but it is wholly mythological, and written in the spoken dialects of the countries about *Muttra*. St. PATRICK is supposed to have written such a book, which is entitled *de tribus Habitaculis*, and this was also entirely mythological.

THERE are also lists of countries, rivers and mountains, in several *Purá-ńas*, and other books; but they are of little or no use, being mere lists of names, without any explanation whatever. They are very incorrectly written, and the context can be of no service, in correcting the bad spelling of proper names. These in general are called *Dés'á-málá*, or garlands of countries; and are of great antiquity: they appear to have been known to MEGASTHENES, and aferwards to PLINY.*

REAL geographical treatises do exist: but they are very scarce, and the owners unwilling, either to part with them, or to allow any copy to be made, particularly for strangers. For they say, that it is highly improper, to impart any knowledge of the state of their country, to foreigners; and they consider these geographical works as copies of the archives of

* CONSULT the 20th Chapter of the 6th Book, in which the account of so many countries all over *India*, cannot be the result of the travels of several individuals, but must be extracted from such lists. In the 17th Chapter of the same book, PLINY says that SENECA, in his attempt towards a description of *India*, had mentioned no less than sixty rivers, one hundred and twenty nations or countries, besides mountains, and in the latter part of the said chapter, out of this account of SENECA, he gives us the names of several mountains, nations and rivers.

IT is my opinion that in the times of PLINY and PTOLEMY, they had a more full and copious geographical account of *India*, than we had forty years ago. Unluckily through the want of regular itineraries and astronomical observations, their longitudes and latitudes were only inferred; and this alone was sufficient to throw the whole of their geographical information, into a shapeless and inextricable mass of confusion.

the government of their country. Seven of them have come to my knowledge, three of which are in my possession. The two oldest are the *Munja-prati-dés'á-vyavast'há*, or an account of various countries, written by *Rájá* MUNJA, in the latter end of the ninth century: it was revised and improved by *Rájá* BHOJA his nephew, in the beginning of the tenth, it is supposed; and this new edition was published under the name of *Bhoja-prati-dés'á-vyavast'há*. These two treatises, which are voluminous, particularly the latter, are still to be found in *Gujarát*, as I was repeatedly assured, by a most respectable *Pandit*, a native of that country, who died some years ago, in my service. I then applied to the late Mr. DUNCAN, Governor of *Bombay*, to procure these two geographical tracts, but in vain: his enquiries however confirmed their existence. These two are not mentioned in any *Sanscrit* book, that I ever saw. The next geographical treatise, is that written by order of the famous BUCCA-RÁYA or BUCCA-SINHA, who ruled in the peninsula in the year of VICRAMÁDITYA, 1341, answering to the year 1285 of our era. It is mentioned in the commentary on the geography of the *Mahá-bhárata*, and it is said, that he wrote an account of the 310 *Rájaships* of *India*, and *Palibothra* is mentioned in it. I suspect that this is the geographical treatise called *Bhuvana-ságara*, or sea of mansions, in the *Dekhin*.

A PASSAGE from it, is cited by professor Sig. BAYER, in which is mentioned the town of *Nisadaburam*, in the *Tamul* dialect,* but in *Sanscrit* *Nahushapur*, or *Naushapur*, from an ancient and famous king of that name.

* IN which *dá* is the mark of the possessive case.

more generally called *Deva-nahusha,* and *Deo-naush,* in the spoken dialects. He appears to be the *Dionysius,* of our ancient mythologists, and reigned near mount *Meru,* now *Mar-coh,* to the S. E. of *Cabul.*

THE fourth is a commentary on the geography of the *Mahá-bhárat,* written by order of the *Rájá* of *Paulastya* in the peninsula, by a *Pandit,* who resided in *Bengal,* in the time of HUSSEIN-SHAH, who began his reign in the year 1489. It is a voluminous work, most curious, and interesting. It is in my possession, except a small portion towards the end, and which I hope to be able to procure. *Palibothra* is mentioned in it.

THE fifth is the *Vicrama-ságara:* the author of it is unknown here: however it is often mentioned in the *Cshétra-samása,* which, according to the author himself, is chiefly taken from the *Vicrama-ságara.* It is said to exist still in the peninsula, and it existed in *Bengal,* in the year 1648. It is considered as a very valuable work, and *Palibothra* is particularly mentioned in it, according to the author of the *Cshétra-samása.* I have only seventeen leaves of this work, and they are certainly interesting. Some, suppose, that it is as old as the time of BUCCA-RÁYA, that it was written by his order, and that the author was a native of the *Dekhin.*

BUT the author could not be a native of that country, otherwise, he would have given a better description of it; for his account of the country about the *Sahyádri* mountains, of which an extract is to be found in the *Cshétra-samása,* is quite unsatisfactory, and obviously erroneous even in the general outlines. The account he gives of *Trichiná-valí* is much better, and there he takes notice of an ancient city, which proves to be the *Bata* of PTOLEMY,

the metropolis of the *Batæ*. Its *Sanscrit* name is *Vat'a* or *Bat'a*, so called because it was situated in the *Bat'áraníya*, or forest of the *Vat'* tree or *Ficus Indica*. Our author says, that it is two *Cos* from *Cuttálam*, called *Curtalam* in Major RENNELL's map of *India*, and to the west of *Tranquebar*: it was a famous place formerly; but it is hardly known in the *Caliyug*, says our author. Close to it is *Trimbálingáli-gráma*. Two *Cos* to the west of *Vat'áraníya*, is *Madhyárjuna*, a considerable place, and five *Cos* from this is *Cumbhácolam* a large place also, inhabited chiefly by pot-makers; hence its name, and it is the *Combaconum* of the maps. The distance between *Cuttálam* and *Cumbhácolam* is nine *Cos*, and according to Major RENNELL's maps, it is about sixteen B. miles, which is sufficiently accurate.

THE sixth is called the *Bhuvana-cośa*, and is declared to be a section of the *Bhavishya-purán'a*. If so, it has been revised, and many additions have been made to it, and very properly, for in its original state, it was a most contemptible performance. As the author mentions the emperor SELIM-SHAH, who died in the year 1552, he is of course posterior to him. It is a valuable work. Additions are always incorporated into the context in *India*, most generally without reference to any authority; and it was formerly so with us; but this is no disparagement in a geographical treatise: for towns, and countries do not disappear, like historical facts, without leaving some vestiges behind. I have only the fourth part of it, which contains the *Gangetick* provinces. The first copy that I saw, contained only the half of what is now in my possession; but it is exactly the same with it, only that some *Pandit*, a native of *Benares*, has

introduced a very inaccurate account of the rebellion of CHAITYAN-SINHA, commonly called CHEYT-SING, in the year, I believe 1781: but the style is different.

THE seventh is the *Cshétra-samása* already mentioned, and which was written by order of BIJJALA, the last *Rájá* of *Patna*, who died in the year 1648. Though a modern work, yet it is nevertheless a valuable and interesting performance. It contains only the *Gangetick* provinces and some parts of the peninsula, such as *Trichiná-vali*, &c. The death of the *Rájá* prevented his *Pandit* JAGGANMOHUN from finishing it, as it was intended for the information of his children.

THE last chapter, which was originally a detached work, is an account of *Pátali-pútra*, and of *Páli-bhátá* as it is called there, and it consists of forty-seven leaves. This was written previously to the geographical treatise, and it gives an account, geographical, historical, and also mythological of these two cities, which were contiguous to each other. It gives also a short history of the *Rájá's* family, and of his ancestors, and on that account only was this small tract originally undertaken. We may of course reasonably suppose that it was written at least 170 years ago.

THE writer informs us that, long after the death of *Rájá* BIJJALA or BAIJJALA, he was earnestly requested by his friends, to complete the work, or at least to arrange the materials, he had already collected, in some order, and to publish it, even in that state. He complied with their request; but it must have been long after the death of the king, for he mentions *Pondichery*; saying, that it was inhabited by *Firangs*, and had

three pretty temples dedicated to the GOD of the *Firangs, Feringies* or *French,* who did not, I believe, settle there before the year 1674. He takes notice also of *Mand'arájya,* or *Madras.*

THE author acts with the utmost candour, and modesty, saying, as I have written the *Prabhoda-chandricá* after the " *Pracriyá-caumudí* (that " is to say from, and after the manner of that book) so I have written this " work after the *Vicrama-ságara,* and also from enquiries, from respect- " able well informed people, and from what, I may have seen myself."

IN the *Cshétra-samása,* two other geographical tracts are mentioned: the first is the *Dacsha-c'hand'aca,* and the other is called *Désá-vali,* which, according to the author's account, seem to be valuable works. There is also a small geographical treatise called *Crita-dhará-vali,* by RÁMÉSWARA, about 200 years old, it is supposed. I have only eighty leaves of it, and it contains some very interesting particulars. In the peninsula, there is a list of fifty-six countries, in high estimation among the natives. It is generally called, in the spoken dialects of *India, Ch'hapana-désá* or the fifty-six countries. It was mentioned first by Mr. BAILLY, who calls it *Chapanna de Chalou.* Two copies were possessed by Dr. BUCHANAN, and I have also procured a few others. All these are most contemptible lists of names, badly spelt, without any explanation whatever, and they differ materially the one from the other. However there is really a valuable copy of it, in the *Tárá-tantra,* and published lately by the Rev. Mr. WARD. I have also another list of countries with proper remarks, from the *Gálava-tantra,* in which there are several most valuable hints. However these two lists must be used cautiously, for there are also several mistakes.

THIS essay on the ancient geography of the *Gangetick* provinces, will consist of three sections. The first will treat of the boundaries, mountains, and rivers. In the second will be described the various districts, with some account of them, as far as procurable. The third section will be a comparative essay, between the geographical accounts of these countries by PTOLEMY, and other ancient geographers in the west, with those of the *Pauránics.* Then occasionally, and collaterally will appear accounts, both historical and geographical of some of the principal towns, such as *Palibothra* and *Pát'ali-putra* now *Patna,* for these two towns were close to each other, exactly like *London* and *Westminister.*

THE former was once the metropolis of *India;* but at a very early period it was destroyed by the *Ganges:* an account of it is in great forwardness, and is nearly ready for the press. Its name in *Sanscrit* was *Páli-bhat'l'á,* to be pronounced *Pali-bhothra,* or nearly so. *Bali-grám* near *Bhágalpur,* never was the metropolis of *India;* yet it was a very ancient city, and its history is very interesting. It was also destroyed by the *Ganges.* *Chattrapur* or *Chattra-grám,* was the metropolis of a district in *Bengal* called *Gangá-Riddha.* It is now *Chitpur,* near *Calcutta,* and it was the *Gangá* or *Gange-Regia* of PTOLEMY. *D'hácá,* or rather *Firingi-Bazar,* is the *Tugma* of PTOLEMY, the *Taukhe* of *El-Edrissi,* and the *Antomela* of PLINY, &c.

ACCURATE copies of these *Sanscrit* treatises on geography, will be deposited with the *Asiatick Society,* and ultimately the originals themselves.

SECTION I.

Boundaries of Anu-Gangam. *Its Forests, Mountains and Rivers.*

ANU-GANGAM, signifies that country, which extends along the banks of the *Ganges*. The *Gangetick* provinces are called to this day *Anonkhenk*, or *Anonkhek* in *Tibet*, and *Enacac*, by the *Tartars*; and they have extended this appellation even to all *India*. The *Ganges* is called *Kankh*, or *Kankhi* in *Tibet*, and *Kengkia*, or *Hengho* by the *Chinese*.*

ANU-GANGAM, has to the north the *Himálaya* mountains, and to the south those of *Vindhya*, with the bay of *Bengal*: the southern boundary of *Arácan*, is also the limit of *Anu-gangam* towards the south, in that part of the country. To the west it has the river *Drishadvatí*, now the *Caggar*.

OF the eastern boundary, we can at present ascertain only a few points, which however will give us the grand outlines. The *Raghu-nandana* mountains to the east of *Arácan* and of *Chatta-grám*, are the boundary in the south-east: from thence it trends towards the N. E. to a place called *Mairám*, eight *Yojanas* or sixty miles, to the east of *Manipur*, which last is

* See Alph. *Tibet*, p. 344, and *Des Guignes*, &c. &c.

upon a river called *Brahmo-tartr*. *Maïrám's* true *Sanscrit* name is *Máya-ráma*, and is amongst hills on the river *Subhadrá*, which goes into the country of *Baramá* according to the *Cshétra-samása*. The *Subhadrá* is the *Kayndwayn*, mentioned in the account of the embassy to *Ava*, and it falls into the *Airávatí*, in the *Burman* empire. From *Maïrám* the boundary goes to a place called *Mánatárá*, near the mountains of *Prabhu-cut'hára*, which join the snowy mountains, in some place unknown. The *Prabhu* mountains are the eastern boundary of *Asam*, and through them is a tremendous chasm made by PARAS'U-RA'MA, and which gives entrance to the *Brahma-putra* into *India*.

BEYOND these are the famous *Udaya*, or *Unnati* mountains, or range, beyond which the sun rises.

THE *Vindhyan* hills extend from the bay of *Bengal*, to the gulf of *Cambay*, and they are divided into three parts, the first or eastern part extends, from the bay of *Bengal*, to the source of the *Narmadá*, and *Sóńa* rivers inclusively, and this part contains the *Rĭcsha*, or *bear* mountains. To the west of this, as far as the gulf of *Cambay*, is the second or western part, the southern part of which is called *Páriyátra*, or *Páripátra*, and the northern part, which extends from the gates of *Dilli* to the gulf of *Cambay*, is called *Raivata*.

Now the third or southern portion of these hills, is simply called *Vindhya*, and is to the south of the source of the rivers *Narmadá*, and *Sóńa*: the rivers *Tápi* or *Tápti*, and the *Vaitarańí* near *Cuttac*, rise from

the hills of *Vindhya*, simply so called. All the *Puráńas* agree, in their description of the hills and rivers of *India*, except that the *Raivat* hills are always omitted in this account: but they make a conspicuous figure in the history of CRĬSHN'A.

THE inferior mountains in this extensive region, are first, the *Rájámehál* hills, called in *Sanscrit*, *Sushuńi:* they are well described in the commentary, on the *Mahá-bhárat:* they are also called *Cacshívat*, from a tribe of *Brahmens* of that name, settled there, and well known to the *Puráńas*.

THEN come the *Chad'gádri*, or the rhinoceros hill, from *Chad'ga*, to be pronounced *Charga* or nearly so, the *Sanscrit* name of that animal; and which still remains in the names of the two districts of *Curruckpur*, and *Currucdea*. They are mentioned in the *Cshétra-samása*. ELIAN observes, that in *India*, they gave the name of *Carcason*, to an animal with a single horn. This word comes from *Charga*, and in the possessive case, and in a derivative form *Chargasya*. In *Persian*, this word is pronounced *Kharrack* and *Khark*.

To the S. W. of these according to the *Gálava-tantra* is the *Grĭdhra-cúťa*, or the vulture peak; the hills, called *Ghiddore* in the maps.

BETWEEN these, and the *Sońa* are the famous hills of *Rájágrĭha*, because there was the royal mansion of JARA'SANDHA. They are called also *Giri-vraja*, because he had there numberless *Cow-pens*. Between

the *Sońa*, and the *Ganges* at *Benares* and *Chunar*, are the *Mauli* hills, called also *Rohita*, or the red hills, and after them the fort of *Rohtas* is denominated.

BETWEEN the *Sońa*, and the *Tamasá*, or *Tonsa*, is the extensive range of *Caimur*, in *Sanscrit*, *Cimmrĭtyú*, so called because it is fortunate to die* amongst them. The hills of *Cálanjara*, and *Chitra-cúťa*, or *Chitra-sánu* in *Bandela-c'hand*, are often mentioned in the *Puráńas*, and also in some poetical works. Beyond the *Chambala* are the famous hills of *Rairata*, which stretch from the *Yamuná*, down to *Gurjarát*, and in a N. W. direction along the *Yamuná*, as far as *Dilli*. That part of them which lies to the west of *Mat'hurá*, as far north as *Dilli*, is called the *D*[illegible] hills, in the *Scanda-puráńa*, and *Máya-giri*, in the *Bhágavat*.† They were the abode of the famous MÁYA, the chief engineer of the *Daityas*. He makes a most conspicuous figure in the *Puráńas*, and particularly in the *Mahá-bhárata*. The scene of his many atchievements, and performances was about *Dilli*. The inhabitants of these hills calls themselves *Máyas* or *Meyos*, to this day: but by their neighbours they are denominated *Meyováti*, or *Mevátis*.

THE inferior mountains in the east, are the *Gára* hills, in the spoken dialects *Gáro*, between the *Brahma-putra* and *Silhet*, along the southern boundary of *Asáma*. They form a very extensive range, the western parts of which are called *Doránga-giri* or *Derán-giri*, from the country they are

* G. Commentary, p. 695 of my MS.

† *Scanda-puráńa*, section of *Revá*. *Bhágavat*, section the 10th.

in; in the eastern parts they are denominated *Námrúpa*, from the country likewise.* To the south of *Gáḍa* or *Gárgánh*, are the *Śúradá* hills, mentioned in the *Cálicá-puráńa*: the natives call them *Śáraidá*, and there are the tombs of the kings of *Ásáma*.

THERE is another range of mountains to the east of *Tiperah*, and, which forming a curve towards the N. E. passes a little to the eastward of the country of an ancient king called HEḌAMBA, or HERAMBA. The name of the country is *Cáśár*, and its metropolis is *C'haspur*, the *Cachara* and *Cuspoor* of the maps. These hills are called *Tiládri*, or mountains of *Tila*, in the *Cshétra-samása*. In them and to eastward of *Cáśára* is *Tiládri-málá-grám*, or the village of *Málá*, in the hills of *Tila*. It is called in the spoken dialects *Tilándrira-málá*, and the author of the above tract, says that it is a pretty place.

To the north of *India* are three ranges of mountains, *Hima* or snowy, is to the north of *Nipála* or *Naya-pála*; *Héma* or the golden mountain, is beyond *Tibet*, and *Nishadha*, is still further north. *Nay-pála* is between the *Pádapa* or foot of the mountains, and *Hima*. Our ancient geographers were acquainted with the two first; *Hima* or *Imaus*; and *Héma*, *Hémada*, *Hemoda*, or *Emodus*. Their information was no doubt very defective, and their ideas concerning them were of course very indistinct and confused, as appears from PTOLEMY's map. That author has added an inferior range, which he calls *Bepyrrhus*. This range, with *Imaus* and

* *Námrúpa*, is different from *Cámrúpa*, which is toward the N. W. in *A'súma*, and the former toward the S. E. *Cámrúpa* is to the north of the *Brahma-putra*, and *Námrúpa* to the south of it.

Emodus, he has disposed in the shape of the letter Y. *Imaus* is the shaft, and the others make the two branches; *Emodus* is to the left or north, and *Bepyrrhus* to the right or south. *Emodus* beyond *Tibet*, is entirely out of its place here, and of course must be rejected. *Bepyrrhus* is derived from the *Sanscrit Bhíma-páda*, or *Bhaya-páda*, or the tremendous pass up, and down the mountains; literally the tremendous footings, rests for the foot, or steps. These words are pronounced by the *Nay-pálese Bhím-phéd*, or *Bhím-pher*, and *Bhay-phed*, or *Bhay-pher*: but in *Hindee* they say *Bhím-païd*, *Bhay-païr* and *Bhím-pairi*, *Bhay-païd*, or *Bhay-païri*.

THE *Pauránics* admit it is true, this etymological derivation of these words, and of *Bhíma-pur* or *Bhaya-pur*, the dreary mansion: but they have transferred the sensation of terror from strangers and travellers, to the inhabitants themselves, and have framed several legends accordingly. When PARASU-RÁMA, undertook to destroy the *Cshettris*, the *C'hasas*, who then lived below in the plains, fled to the mountains, where they concealed themselves in the greatest dismay, and consternation. A vast body of them went to *Jalpésa* or the place of the lord of speech, at the foot of the hills and a little to the eastward of the *Tistá*, to consult him, and claim his protection. They then ascended the tremendous *Ghâts*, according to the *Cshétra-samása*. In the same treatise, it is said, another body of them to the north of *Asáma*, ascended the hills and settled at a place called also *Bhíma-vati-puri*, or the town replete with fear and terror, more commonly *Bhím-puri* and *Bhím-païri*, which implies that the town *pur*, the valleys and passes *pa'r* or *paër*, at the foot of these hills, were filled with alarm, and the inhabitants still tremble at the name of PARASU-RÁMA. In the

commentary on the *Mahá-bhárat*, the name of this place* is written *Bhíma-spharddhá*, or rather *Bhíma-sparddha*, because BHÍMA, having defeated, in these passes, the army of *Báńásura*, laughed and rejoiced in consequence of his victory. The first etymology, I think is by far preferable. This appears to be the mount *Bepyrrhus* of PTOLEMY, and its erroneous direction in his map may be rectified: *Bepyrrhus*, and *Ottorocorrha* are parts of the *Pádapa*, or foot of mount *Himálaya*, and ought to be connected as such, *Bepyrrhus*, to the west and *Ottorocorrha* to the east, and to the north of *Ásama*; for the latter is only a prolongation of the former.

THE country of *Gáda* or *Gáda-gráma* is pronounced by the natives *Gor-ganh*, or *Gaur-ganh*, that is to say the town of GOR, whatever be its meaning, and through the rest of *India* it is called *Gor*, and also by our writers of the 17th century. Even PTOLEMY writes it *Corrha* as in *Ottoro-corrha*. This country is generally called *Ásáma*, and is divided into two parts *Uttara*, or *Uttaro-gora*, and *Dacshina-gora*, in the spoken dialects *Uttar-gol*, and *Dekhin-gol*; that is to say, north and south *Gora*. In the spoken dialects these two divisions, are also called *Uttar-páda*, and *Dekhin-páda*, that is to say the N. and S. division.

THE *Damasi* of PTOLEMY, imply the southern mountains, from the *Sanscrit Yámya*, and *Yámasya*, which signify the south; because YAMA rules there. These words, in the spoken dialects, are pronounced *Jamya*,

* PAGE 538 of my MS.

and *Jamasya*, from which last the *Greeks* made *Damasoi*, as *Diamuna* for *Jamuná;* and when PLINY says, that the *Hindús* called the southern parts of the world *Dramasa*, we should read *Diamasa* or *Damasa.* Besides, JAMA, or PLUTO, is supposed to reside particularly there also, hence these mountains or part of them are called *Jama-dhara*, which imply either the southern mountains, or the mountains of JAMA, the ruler of the south, in *Sanscrit.* In the spoken dialects, they say *Jamdhera*, from which BERNIER made *Chamdara.**

BEYOND *Ásáma* are the *Prabhu-cút'hára* mountains, beyond which are those called *Udaya*, or from behind which the sun makes his appearance.

IMMEDIATELY after the mountains of *Ásáma*, according to PTOLEMY, are those called *Semanthini*, which appear to be the *Udaya* mountains of the *Pauránics*, and the *Unnati* of lexicons. These are declared to be the *Samanta*, or the very limit of the world, from which PTOLEMY made *Semanthini*. We may also say *Samunnati* the very place of the rising of the sun; for the particle *Sam* is used here intensively. *Samanta* is found in lexicons; the other never to the best of my knowledge; still it is admissible, for it is correct and grammatical.

LET us pass to the mountains to the east of *Bengal*. Between that country, and *Traipura*, there is a range of hills, which passes close to *Comillah*, then all along the sea shore, and ends near *Chatgánh*. This

* Account of *Ásáma*, *Asiatick Researches*, Vol. 2d p. 175.

range is called *Raghu-nandana* in the *Cshétra-samása,* and in the district of *Chat'gánh* there are two portions of it, one is called *Chandra-s'éc'hara,* or *Chandra-giri;* in this is *Sitá-cunda,* or the pool of SITÁ, and the burning well. The other portion is called *Virúpácshya.*

THE mountains to the eastward of *Traipura,* and of *Chat'gánh,* are mentioned in the above geographical treatise: in the northern parts they are called the *Tiládri* or *Tailádri* mountains, with several places of that name, as we have seen before. The *Peguers* are called also *Talians,* and it is possible that the *Tailádri* or the mountain of *Tilá* or *Tailá* may have been so called from that circumstance: for they constitute, at least in the lower parts of that range, the natural boundary between *India,* and the *Talian* country or *Pegu.* Between *Arácan,* and *Avá,* is the famous pass of *Tálla* or *Tálláki.*

IN the *Cshétra-samása* the *Carna-phulli* or *Chat'gánh* river, is said to come from the *Jayádri* or mountains of victory, and the *Nábhi* or *Náf* river, from the *Suvarna* or golden mountains; but these are portions only of the above range. The mountains, as well as the country to the eastward of *Trai-pura* are often called *Reang* by the natives. When we read in Major Dow's history of *Hindoostan,* that *Sultan* SUJAH fled from *D'hácca* to *Arácan,* through the almost impervious forests and mountains of *Rangamati,* it is a mistake, and it should be the forests and mountains of *Reang.* It is not likely that, that unfortunate prince should fly from *D'hácca* to *Rangámati* on the borders of *Asáma,* a great way towards the

north; but it is more natural to suppose, that he darted at once into the wilds of *Trai-pura* and *Reang*.

PTOLEMY has bestowed the name of *Maiandrus* on this range, but which is now unknown. It is probably derived from *Mayun*, a tribe between *Chat'gánh*, and *Árácan** according to Dr. BUCHANAN. In this case *Mayunádri* signifies the *Mayun* mountains, and the *Peguers* are also called *Moan*.†

BY a strange fatality, the northern extremity of mount *Maiandrus* in PTOLEMY's maps, is brought close to the town of *Alosanga*, now *Ellasing* on the *Lojung* river, to the N. W. of *D'hácca*. This mistake is entirely owing to his tables of longitude and latitude, which were originally erroneous, and probably have been made worse and worse by transcribers: but this may be easily rectified, by adverting to the interesting particulars, which he mentions concerning mount *Maiandrus*. In the upper parts of it, says he, are the *Tilaidai*, or the inhabitants of the *Tiládri* or *Tilá* mountains mentioned before; these are also called *Basadæ*. In the *Vámana-puráńa*, section of the earth, the *Bhasada* tribes are mentioned, as living in the easternmost parts of *India*. PTOLEMY says, that the *Basadæs* had a short nose as if clipped, and were very hairy, with a broad chest, and a broad forehead. They were of a white colour, and I suppose like that of the *Peguers*, called by *Persian* writers, a wheat colour, and in *Sanscrit Capiśa*.

* *Asiatick Researches*, Vol. 6th, p. 228.
† *Asiatick Researches*, Vol. 5th, p. 225.

ON one side of mount *Maiandrus*, according to our author, are the *Nanga-logæ*, which, he says, signifies naked people, and this is to this day the true meaning of *Nanga-loga* in *Hindí*: their country is repeatedly called *Nagna-désa*, or country of the naked in the *Puráńas*, and they call themselves *Nanotás* or the naked, but this word they generally pronounce *Lanctá*.* They are called also *Cuci*, and in the *Cshétra-samása* it is said, that the original name is *Camu*, and *Cemuca*, which are pronounced in the dialect of that country *Ceu*, *Ceuca* or *Ceucis* and *Portuguese* writers mention the country of *Cu*, to the eastward of *Bengal*.

THE *Vindhyan* mountains are in general covered with forests called in *Sanscrit*, *Aranya* or *Atavi*, and this last implies an impervious wood, or nearly so. The *Vindhyátavis*, are often mentioned in the *Puráńas*, and poetical works. They are divided into forest-cantons, mentioned in the lists of countries in the *Puráńas*, and in geographical works among these forest-cantons, ten are of more renown, than the others: these are to the east of the river *Sońa*, and are called in the above lists *Dasárna*, and in geographical tracts *Dasáranya*, or the ten forests, and in every one of them is a strong-hold or fort *Riňa*, and *Dasárńa* signifies the ten forts. Another name for these forts is *Uttamárńa*, which implies their pre-eminence, and superiority of power above the others. These ten strongholds are probably the *Dasapur*, or decapolis of the last section but one of the *Padma-puráńa*, and of *Chásas* also. There resided ten chiefs, who availing themselves of the supineness of their neighbours below, became hill robbers, and obtained at various periods much might and honor. They were like the savage

* *Asiatick Researches*, Vol. 7th, p. 183.

tribes of *Rájámehál*, only they acted upon a larger, and of course upon a more honorable scale.

THESE forests are in general called *Jhári-c'hand'a*, always pronounced *Jhári-c'hand* in the spoken dialects, which signifies a country abounding with *Jhári*, or places overgrown with thickets, and underwood. However there are many extensive forests of large and tall trees of various sorts, but under these there is no grass, and very seldom any underwood: therefore the copses are most valuable, being fit for the grazing of cattle.

THESE ten cantons included all the woods, hills and wilds of south *Bahar*, with the two districts of *Surugunjá*, and *Gangápur* in the south. We have also the *Dwádaśáraṅya*, or twelve forest-cantons, including the ten before mentioned with the addition of *Bandela-c'hand* and *Baghela-c'hand*. Another name for such woods and thickets is *Jhánci* and *Jháncar*; which the natives of these forests, generally pronounce *Dángi* and *Dángar*, according to the *Cshétra-samása*, and to the natives also, who call themselves *Dángayas* from *Bandela-c'hand*, all the way to the bay of *Bengal*, and their country *Dángáya*. The other *Hindus* however call the whole *Jhár-c'hand*, and it is noticed in Dow's history of *India*, and in that of *Bengal* by Major STEWART,* and also either by TAVERNIER or BERNIER, but supposed by them to be a town in the vicinity of *Berhampur*, instead of an extensive forest. They call it *Geharcunda*, and suppose it to mean a cold place. In *Bengal* they call it often *Jangal-ter* and

* History of Bengal, p. 123. 265. 371.

in the *Cshétra-samása, Jangal-cshétra* and *Jár-c'handi,* all implying the woody country. In the Company's Registers, they are called the *Jungle-mehúls* or forest-cantons.

According to Major Dow's history, when the emperor Firose III, in the year 1358, was returning from *Bengal,* he passed through the *Padmávatí* forest, which is one of the old names of *Patna,* once the metropolis of that country. These forests abounded with elephants, and the emperor caught many. For a similar reason, the mountains and forests of *Jhár-c'hand* are called, in the Peutingerian tables, the *Lymodus* mountains, abounding with elephants, and placed there to the south of the *Ganges.* They really were in the country of *Magadh* or *Magd,* as generally pronounced, and which was also the name of *Patna* and of south *Bahar.* Much information concerning *India,* was derived from *Arabian* merchants and sailors, by whom the *Greek* and *Roman* fleets were chiefly manned. These to the names of countries prefixed the *Arabic* article *Al,* as in *Al-tibet, Al-sind,* &c.: thus they said *Al-mogd* for *Magadh, Al-murica* and *Al-áryyaca,* for *Mura* or *Muricá* and *Áryyácá,* from which the *Greeks* made *Limyrica* and *Lariaca. El-maied* or *Patna* is placed, in the above tables, 250 *Roman* miles to the eastward of the confluence of the *Jumná* with the *Ganges,* and its name is written there *Elymaide.* These forests are called *Ricsha-ván* or bear forests, and the inhabitants *Bhallát'a* or *Bhállat'ha,* bear hunters or bear killers* These are the *Phyllitæ* of Ptolemy, and the *Bulloits* of Captain Robert Covert. There were also the *Dryllo-phyllitæ,* pro-

* *Mahá-bhárat, Bhishma,* section and commentary.

bably from some place called *Derowly*: the *Condali* now the *Gandø* (as *Bengala*, from *Banga*) were part of the *Phyllitæ*. This shews that these bear hunters were spread over a most extensive region.

As these extensive forests abound with snakes, the country is called in *Sanscrit*, *Ahi-cshétra*, or snake country, and *Ahi-ch'hatra*, from the snakes spreading there, their umbrellas or hoods. In the spoken dialects, they say *Aic-het* and *Aic-shet*. The country and mountains of *Aic-shet* are well known all over the peninsula, according to Dr. F. BUCHANAN in his account of *Mysore*. PTOLEMY gives to the mountains of south *Bahar* and in the western parts of *Bengal*, the name of *Uxentus* obviously from *Aic-shet*. In the southern parts, or in *Burrá-nágpur*, and adjacent countries, he calls them *Adisat'hrus* from *Ahich'hatra*. The country about the *Vindhyan* hills, from *Rájámehál* to *Chunár*, is divided into *Antara-giri*, or within the hills, and *Bahira-giri*, or without the hills, and this last is applied to the country to the south of *Patna* along the *Ganges*.

Now let us pass to the rivers, and I shall describe first, those on the right of the *Ganges*, then the rivers on the left of it; and I shall conclude this section with an account of the *Ganges* itself. This I believe is the best way, as it will obviate many repetitions.

THE first river of note below *Hurdwár*, and on the right side of the *Ganges*, is the *Cálindí* or *Cálini*, for both are used indifferently by the natives, and which falls into the *Ganges* near *Canoge*. She is considered as the younger sister of the *Yamuná*: hence it is called the lesser *Yamuná*

or *Cálindí.* This accounts for PTOLEMY mistaking it for the elder or greater *Yamuná*, and making but one river of the two; DON JOAN DE BARROS did the same, when he says that *Canoge* was at the confluence of the *Jamuná* with the *Ganges*. Mr. D'ANVILLE, better informed, removed the greater *Jumná* to its proper place; but carried along with it *Canoge*, which accordingly he placed near *Allahábad*, at least in his first maps.

THE royal road from the *Indus* to *Palibothra* crossed this river at a place called *Cáliní-pacsha* according to *Megasthenes*, and now probably *K'hoda-gunge*; *Cáliní-pacsha* in *Sanscrit* signifies a place near the *Cáliní*.

THE next is the blue *Yamuná* or *Cálindí*, the daughter of the sun, the sister of the last MANU, and also of YAMA or SAMANA, our PLUTO or SUMMANUS. Her relationship with the lesser *Cálindí* or *Cáliní* is not noticed by the *Pauránics*, though otherwise well known. In the spoken dialects it is called *Jamuná*, *Jumná*, and *Jubuná* particularly in *Bengal*. It is called *Diamuna* by PTOLEMY, *Jomanes* by PLINY, and *Jobares* by ARRIAN, probably for *Jobanes* or *Jubuna*. It is called *Cálindí* because it has its source in the hilly country of *Cálindá*, called *Culindá* in the Geographical Commentaries, on the *Mahá-bhárata*. It is the *Culindrine* of PTOLEMY from *Culindán*, a derivative from *Culindá*.

THE confluence of the *Gangá* and *Yamuná* at *Prayága* is called *Triveni* by the *Pauránics*, because three rivers are supposed to meet there; but the third is by no means obvious to the sight. It is the famous *Sarasvati*, which comes out of the hills to the west of the *Yamuná*, passes

close to *Thaneser*, loses itself in the great sandy desart, and re-appears at *Prayág*, humbly oozing from under one of the towers of the fort, as if ashamed of herself. Indeed she may blush at her own imprudence: for she is the goddess of learning and knowledge, and was then coming down the country with a book in her hand, when she entered the sandy desart, and unexpectedly was assailed by numerous demons, with frightful countenances, making a dreadful noise. Ashamed of her own want of foresight she sank into the ground, and re-appeared at *Práyága* or *Allahabad*, for as justly observed, learning alone is insufficient.

THESE three rivers flow then together, as far as the southern *Triveńí* in *Bengal*, forming the *Triveńí*, or the three plaited locks: for their waters do not mix, but keep distinct all the way. The waters of the *Yamuná* are blue, those of the *Sarasvatí* white, and the *Ganges* is of a muddy yellowish colour. These appearances are owing partly to the nature of the soil below, and above to the reflexion of light from the clouds.

THE *Tamasá*, or dark river, from its being skirted, at least formerly, with gloomy forests, is called *Tonsa* or *Tonso* in the spoken dialects, and by PTOLEMY *Touso* or *Tousoa*.

IT is not to be confounded with the *Sońa*; for the *Touso*, according to him falls into the *Ganges*, above *Cindia* now *Canti* or *Mirzapur*. It is occasionally called *Parńaśá*, as in the *Váyu* and *Matsya-puráńas*; and

* Section of the earth.

at its confluence with the *Ganges*, there is a very ancient place, and fort called to this day *Parńasá*.

THE next river is the hateful *Carmmanásá*, so called, because, by the contact alone of its waters, we lose at once the fruit of all our good works. Its source is in that part of the *Vindhya* hills called in the *Puránas* *Vindhya-maulicá*, which implies the heads, peaks or summits of the original mountains of *Vindhya*.

THIS mountain presumed once to rear his head, above that of *Himálaya*, and thus consigned it, and the intermediate country, to total darkness. One day VINDHYA perceiving the sage AGASTYA his spiritual guide, prostrated himself to the ground before him, as usual, when the sage as a punishment for his insolence, ordered him to remain in that posture. We had such mountains formerly in the west, which kept the greatest part of *Europe* in constant darkness, and which must have met with a similar fate, though not recorded. All the ground he covers with his huge frame is denominated *Maulí*, or the heads or peaks of *Vindhya*, and is declared to be the original VINDHYA, which gives its name to the whole range, from sea to sea, and is supposed to extend from the *Sońa* to the *Tonsa*. As the *Carmmanásá* comes from the country of *Maulí*, there is then a strong presumption, that it is the river *Omalis* of *Megasthenes*: thus the great river, which he calls *Commenasis*, is the *Sarayú*, mora. so called, because it comes from the country of *Comarch*, or *A* so called ver *Cacut'his* of the same author is the *Puna-puná*, and i so called becaus flows through the country of

Cícaṫa. It is also called *Magadhí* by the *Pauráṅics*, for a similar reason. In this manner the *Yamuná* is also called *Cálindí*, because it comes from the hilly country of *Cálinda*, as I observed before.

THE waters of the river *Maulí* were originally as pure, and beneficial to mankind, as those of any river in the country. However they were long after infected and spoiled, through a most strange, and unheard of circumstance, in consequence of which its present name was bestowed upon it.

TRI-ŚANCU was a famous, and powerful king, who lived at a very early period, and through religious austerities, and spells, presumed to ascend to heaven with his family. The gods enraged at his insolence, opposed him, and he remains suspended half way with his head downwards. From his mouth issues a bloody saliva, of a most baneful nature. It falls on *Vindhya*, and gives to these mountains a reddish hue: hence they are called *Rohita* or *Lohita*, the red and bloody hills in the vicinity of *Rotas.* It is unnecessary to remark, that this infectious saliva, mixing with the waters of the river *Maulí*, would naturally infect, and render them most inimical to religious purposes. This legend is well known; but the best account I ever saw, is in the *Mahá-Rámáyaṅa*, in a dialogue between AGASTYA, and HANUMA'N. The next is the *Śoṅa*, or red river: in the *Puráṅas* it is constantly called *Śoṅa*, and I believe never otherwise. In the *Amara cosa*, and other tracts, I am told it is called *Hiraṅya-báhu* implying the golden arm, or branch of a river, or the golden canal or channel. These expressions imply an arm or branch of the *Śoṅa*, which really forms two branches, before it falls into the *Ganges*. The easternmost, through

the accumulation of sand, is now nearly filled up, and probably will soon disappear.

THE epithet of golden, does by no means imply that gold was found in its sands. It was so called probably, on account of the influx of gold, and wealth, arising from the extensive trade carried on through it; for it was certainly a place of shelter for all the large trading boats, during the stormy weather, and the rainy season.

IN the extracts from *Megasthenes* by PLINY and ARRIAN, the *Sonus* and *Erannoboas* appear, either as two distinct rivers, or as two arms of the same river. Be this as it may, ARRIAN says, that the *Erannoboas* was the third river in *India*, which is not true. But I suppose, that *Megasthenes* meant only the *Gangetick* provinces: for he says that the *Ganges* was the first and largest: he mentions next the *Commenasis* or *Sarayú*, from the country of *Commanh*, as a very large river, the third large river is then the *Erannoboas* or river *Sońa*.

PTOLEMY finding himself peculiarly embarrassed with regard to this river, and the metropolis of *India* situated on its banks, thought proper to suppress it entirely. Others have done the same, under similar distressful circumstances. It is however well known to this day, under the denomination of *Hirańya-báhá*, even to every school boy, in the *Gángetick* provinces, and in them there is no other river of that name.

THE origin of the *Sońa*, and of the *Narmadá* is thus described by F. TIEFFENTHALER, on the authority of an *English* officer, who surveyed

it about the year 1771* "according to an *English* Engineer, who went "from *Allahabád* to the source of the *Narmadá*, there are three rivers, "which have their origin from a pool eight yards long and six broad, and "surrounded by a border of brick. This pool is in the middle of the "village of *Amarcantaca*. Above it is a rising ground about fifty yards "high, on which *Bráhmens* have built houses. The *Narmadá* flows "from the said pool, a mile and half towards the east, then falls with "violence down a declivity of about twenty-six yards, and then runs with "velocity towards a village called *Capildara* and from this place through "an extensive forest, and then turning towards the west, it goes to "*Garamandel* and thence into the sea. In coming out of the above pool "it is one yard broad."

"THE *Sone* makes its first appearance, about half a mile from the pool, "and then runs through a very narrow bed, down a declivity of about "twenty-five yards. Five miles thence, it is lost in the sands; then collect-"ing itself again into one body, it becomes a considerable stream, and "goes to *Rhotas*. The *Juhala* (*Johila*) is first seen about three miles from "the pool, and is but an insignificant stream."

TIEFFENTHALER has omitted the name of the officer, but it was WILLIAM BRUCE, a Major in the Company's service, and mentioned by Major RENNEL.†

* *Beschreibung von Hindoostan*, &c. p. 298. [illegible] is given also, from native authorities by Captain BLUNT, *Asiatick Rese*[illegible]

† SEE Memoir of a map, &c. p. 234.

THE next river is the *Puna-puná*, which signifies again and again, in a mystical sense; for it removes sins again and again. It is a most holy stream, and is called also *Magadhí*, because it flows through the country of *Magadha* or *Cícata*. Hence this river might be called also *Cícatí*, and it is the *Cacuthis* of *Megasthenes*. Then comes the *Phalgu*, the *Fulgo* of the maps. I thought formerly, that it was the anonymous river of PTOLEMY, which he derives from the mountainous regions of *Uxentos*, in *Hindí*, *Aicshet*, from the *Sanscrit Ahicshétra*. Our author has pretty well pointed out its confluence with the *Ganges* near *Mudgir*, where it receives another river from the south, called the *Kewle* in the maps, and which is really the anonymous stream of that author, as it appears from several towns on its banks: but PTOLEMY has lengthened its course beyond measure; as I shall show hereafter.

LET us now proceed to the *Sulácshní*, or *Chandravatí*, according to the *Cshétra-samása*. It is now called the river *Chandan*, because it flows through the *Van* or groves of *Chandra*, in the spoken dialects *Chandwan*, or *Chandan*. In the maps it is called *Gogá*, which should be written *Caucá*, because according to the above tract, it falls into the *Ganges*, at a place called *Cucu*, and in a derivative form *Caucavá*, *Caucwá*, or *Caucá*. It flows a little to the eastward of *Bhagalpur*: but the place, originally so called, has been long ago swallowed up by the *Ganges*, along with the town of *Bali-grám*. In the *Jina-vilás*, it is called *Aranya-báhá*, or the torrent from the wilderness, being really nothing more.

The other rivers, as far as *Tamlook*, are from the *Cshétra-samása.* The *Rádá* now the *Bánslí,* falls into the *Ganges* near *Jungypur.* I believe it should be written *Rád'há,* because it flows through the country of that name. The *Dwáracá* is next: then, the *Mayurácshí* or with the eyes of a *Mayura,* or peacock; this is the river *More.* To the N. E. of *Jemuyácandi* are the following small rivers, the *Gocarńí,* and beyond this the *Chílá.* and the *Grívamotícá,* in the spoken dialects *Gármorá.* Their path towards the *Ganges,* is winding and intricate.

The next river is the *Bacréswarí,* which comes from the hot wells of *Bacréswara-mahádéva,* or with the crooked *Linga.* These hot wells are of course a most famous and holy place of worship. It falls into the *Ganges* above *Catwá,* and it is called in the maps *Báblá.*

The *Ají,* or resplendent river is the next: its name at full length is *Ajávatí* or *Ajámati,* full of resplendence. The *Ajmati,* as it is pronounced, is the *Amystis* of *Megasthenes,* instead of *Asmytis.* It fell into the *Ganges,* according to Arrian, near a town called *Catadupa,* the present, and real name of which is *Cata-dwípa;* but it is more generally called *Catwá.* The *Ají* is called also *Ajayá, Ajayí* and *Ajasá,* in the *Gálava-Tantra.* As *Ajayá* may be supposed to signify invincible, it is declared, that whatever man bathes in its waters, thereby becomes unconquerable. The next river is the *Dámodara,* one of the sacred names of Vishnu, and according to the *Cshétra-samása,* it is the *Vedasmriti,* or *Vedavatí* of the *Puráńas.* Another name for it is *Dévanad,* especially in the upper parts of its course. In the spoken dialects it is called *Damodi* or *Damodi.* It is

the *Andomatis* of ARRIAN, who says that it comes, as well as the *Caculhis*, now the *Puna-puná*, from the country of the *Mandiadini*, in *Sanscrit Manda-bhágya* or *Manda-dhanya.*

THE *Dáriceśwarí*, or *Dáriceśí*, is called *Dwáraceśí* in the *Gálava-Tantra.* It is the *Dalkisor* of the maps, near *Bishenpur.* It is so called from *Dáriceśwara-mahádéva.*

THEN comes the *Śilávatí, Śailavatí*, or *Śailamatí** called simply *Śailaya* by the natives, and *Selai* in the maps. It is the subject of several pretty legends, and a damsel born on its banks, and called also ŚAILAMATI from that circumstance, makes a most conspicuous figure in the *Vrihatcat'há.* It is the *Solomatis* of *Megasthenes.*

THE next river is the *Cansávatí*, called *Cansaya* by the natives, and *Cassai* in the maps. The three last rivers joining together form the *Rúpa-Náráyańa*, or with the countenance of him, whose abode is in the waters, and who is VISHNU.

THEN comes the *Suvarńa-réc'há*, or *Hirańya-réc'há*, that is to say the golden streak. It is called also in the *Puráńas*, in the list of rivers, *Śuctimatí*, flowing from the *Ricsha*, or bear mountains. Its name signifies abounding with shells, in *Sanscrit Śucti, Sanc'ha*, or *Cambu.*

* IN *Sanscrit* the words *vat*, *vati*, or *mati*, *man*, and *mant* originally signify, in composition, likeness; but in many instances they imply fullness, abundance. In *Latin* we have *Farcimen*, *farcimentum* likewise, &c

From *Cambu*, or *Cambuja*, in a derivative form, comes the *Cambuson* mouth of Ptolemy and which, he thought, as well as many others till lately, communicated with the *Ganges*, or even was a branch of it.

The *Suvarńa-réc'há*, it is true, does not fall into the *Ganges* any more than the four rivers, which I am going to mention; but they are so situated, that it is necessary to give some account of them, for the better understanding of this Geographical Essay. Of these four rivers the first is the *Sońa*, which flows by *Balasore*, and is not noticed, as far as I know, in the *Puráńas*.

The next is the *Vaitarańí*, which runs by *Yájápur*, the *Jaugepoor* of the maps. In the upper part of its course, it is called *Cocilá*, and in the spoken dialects *Coil*.

There are two rivers of that name, the greater and the lesser; this last is I believe the *Salundy* of the maps. The greater *Vaitarańí* is generally called *Chittrotpalá* in the *Puráńas*. The third is the *Bráhmańí*, called *Śanc'há* in the upper part of its course. This and the *Vaitarańí* come from the district of *Chuta-Nagpur*.

The fourth river is the *Mahá-nada* or *Mahá-nadí*, that is to say the great river. It is mentioned in the lists of rivers in the *Puráńas*, but otherwise it is seldom noticed. It passes by *Cat'aca*.

Ptolemy considers the *Cocilá* and *Bráhmańí* rivers as one, which he calls *Adamas*, or diamond river, and to the *Mahá-nadí* he gives the name of

Dosaron. He is however mistaken: the *Mahá-nadi* is the diamond river, and his *Dosaron* consists of the united streams of the *Bráhmaní*, and the *Cocilá* and is so called, because, they come from the *Dasáranya* also *Dasárna*, or the ten forest-cantons. He might indeed have been led into this mistake very easily, for the *Bráhmaní* and *Cocilá* come from a diamond country in *Chuta-Nagpur*, and in Major RENNELL's general map of *India*, these diamond mines towards the source of these two rivers are mentioned, and seem to extend over a large tract of ground.

BEFORE we pass over to the other side of the *Ganges*, let us consider the rivers which fall into the *Yamuná*. The first river is the *Goghas*, to be pronounced *Goghus*, which passes close to *Amara*, or *Amere* near *Jaypur*. It comes from the east, and is first noticed at a place called *Ichrowle*, as it passes to the north of it, at some distance. It winds then towards the S. W. and goes towards *Amere* and *Jaypur*, thence close to *Bagroo*, when it turns to the south and soon after to the S. E. The village of *Ichrowle*, being near the *Goghus*, is also called *Goghus* after it, or *Cookus*, as it is written in ARROWSMITH's map: but it is considered by that famous geographer, as a different place from *Ichrowle*. This river is called *Damiadee*, by some of our writers of the seventeenth century, and is supposed by them to come from the mountainous district of *Hindoon*, and then to flow close to that city towards the west, and to fall into the *Indus* at *Bácár*, according to Captain R. COVERT, who was there I believe in the year 1609 or 1610. This is by no means a new idea, for this is the river without a name mentioned by PTOLEMY, who places, near its source, a town called *Gagasmira*, in which the names of the *Goghas*, and of the town of *Amere* are suffi-

ciently obvious. Some respectable travellers, who have occasionally visited that country are of the same opinion, being deceived by seeing that river flowing towards the west a considerable way.

THE town of *Hindoon* still exists, and the inhabitants of the adjacent country who were formerly great robbers, trusting to their fastnesses, among the hills, are still so, whenever they can plunder with safety. It is most erroneously called *Hindour*, in ARROWSMITH's map, and I am sorry to observe, that otherwise admirable work disfigured by bad orthography, the result of too much hurry, and carelessness, and the errors are equally gross and numerous, and sometimes truly ludicrous. As to the *Damiadee*,* this appellation is now absolutely unknown. The first notice I had of the *Goghas* was from a native surveyor, whom I sent to survey the *Panjáb*, and who accidentally passed through *Jaypur*, but remained there several days.

THE *Damiadee* was first noticed by the SANSONS in *France*; but was omitted since by every geographer, I believe, such as the Sieur ROBERT, the famous D'ANVILLE, &c; but it was revived by Major RENNELL, under the name of *Dummody*. I think its real name was *Dhúmyátí*, from a thin mist like smoke, arising from its bed. Several rivers in *India* are so named: thus the *Hiraṅya-báhá*, or eastern branch of the *Śoṅa*, is called *Cujjhatí*, or *Cúhí*† from *Cúha* a mist hovering occasionally over its bed. As this branch of the *Śoṅa* has disappeared or nearly so, this fog is no longer to be

* SEE ANDREW BRICE's Dictionary ad vocem and others.

† COMMENTARY on the Geog. of the M. Bh.

seen. I think, this has been also the fate of the *Dhúmyátí*, which is now absorbed by the sands. This *Dhúmyátí*, seen at *Baccar* by Capt. COVERT, did not come from *Hendown*, but from some place in the desert, still unknown, but I suspect that it is the river, without name, placed, in ARROWSMITH'S map, to the E. N. E. of *Jaysulmere*. It passes near a village called *Lauty* or *Látyanh*, which village is said to be twenty *Cos* to the east of *Jaysulmere*, by the late Major D. FALVEY, who travelled twice that way, in the years 1787 and 1780: according to him there is no river, nor branch of the *Indus* between *Jaysulmere*, and *Baccar*. He was a well informed man, who understood the country languages, and in his route he always took particular notice of the rivers which he crossed. The *Damiadee* is now called by the natives, *Lohree* or *Rohree*, from a town of that name, near its confluence with the *Indus*. I am assured, that, during the rains, the backwater from the *Indus*, runs up the dry bed of a river, for a space of three days. This dry bed is supposed, to have been formerly the bed of a river, formed by the united streams of the rivers *Cuggar*, and *Chitangh* from the plains of *Curu-cshetra*, but this I think highly improbable.

THE next is the *Charmmanwatí*, or abounding with hides. It is often mentioned in the *Puráńas*, and is called also *Charmmabala*, and *Śivanada*, in the spoken dialects *Chambal* and *Seonad*. It is sometimes represented as reddened with the bloody hides put to steep in its water.*

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* IN the *Mégha Dúta* this river is said to have originated in the blood shed by RANTI DÉVA at the *Gomédhás* or offerings of kine.

THE hides, under the name of *Chembelis*, were formerly an article of trade.* The country about its source is called *Charmma-dwípa*, which is certainly between waters or rivers, which abound in that country. There is a town called *Sibnagara*, or more generally *Seonah*, the town of ŚIVA, after whom this river is denominated.

THE *Siprá*, *Śiprá*, *Cshiprá*, called also the *Avantí* river, falls into the *Chambal*.

THE *Sindhu* or *Sind*, is occasionally mentioned in the *Puráńas*, as well as the little river *Párá*, commonly called *Párvatí*, which, after winding to the north of *Narwár*, falls into the *Sindhu* near *Vijayagar*. It is famous for its noisy falls, and romantic scenes on its banks, and the numerous flocks of cranes and wild geese to be seen there, particularly at *Buraichá* west of *Narwár*. The next is the little river *Paujá*, which falls into the *Yamuná*, and is called in the spoken dialects *Pauja*, and in the maps *Pohuj*.

THE *Vetravatí*, or abounding with withies, is a most sacred river. *Vetra* or *Betra* is a withy, and so is *Vithr* in the old *Saxon*. In the spoken dialects and in *English*, the letter R is omitted; in *Hindí* they say *Beit* and in *English With* or *withy*. In the spoken dialects, it is called *Betwá* and *Betwántí*.

THE river *Dussaun*, which falls into the *Vetravatí* is probably the *Daśárńá* of the *Pauráńics*.

* SEE Dictionnaire de Commerce.

THE next river is that, which we call the *Cane:* but its true name is *Ceyán*, and the author, of the *Cshétra-samása*, says, that it is the *Criyá*, or *Criyána* of the *Puráńas*, and called *Ceyan* in the spoken dialects. Another name for it is *Crishna-gangá*, which, according to the *Varáha-puráńa* flows by *Cálanjara*.

LET us now pass to the rivers to the north of the *Ganges*, or on the left of it. The first is the *Sarávatí*, or full of reeds: another name of the same import is *Báńa-gangá*, this is used by natives: in the *Máhá-bhárata*, it is called *Su-Vámá*, or most beautiful: its present name, and of the same import is *Rama-gangá*, or *Ramya-gangá*. In the *Śaravan*, or *Śaraban*, that is to say the thickets of reeds on its banks, CÁRTICÉYA was born. This name is sometimes applied to the river itself, though improperly, and from *Śaraban*, PTOLEMY made *Śarabon* and *Śarabos*. It is called *Su-shomá*, in the *Bhágavat*, or the most beautiful. It may be also translated the beautiful *Shomá* or *Somá*.

IN the *Amara-cośa*, and commentary, it is called *Sausamí* in a derivative form from *Su-samí*. It is declared there to be in the famous and extensive country of *Uśínara*. The reason for its being introduced into that work is, " because, there is in it a city called *Cant'ha*, and *Sau-samí-* " *cant'ha*. This word is of the neuter gender, provided the compound " term be the name of a town in *Uśínara*, else it is feminine. Example; " *Sau-samí-cant'ha*, and *Dacshińa-cant'há* names, of towns; the first in " *Uśínara*, the other out of that country.* These two towns still exist:

* *Amara-cośa*, and translation by Mr. COLEBROOKE, p. 385.

the first, in the late surveys made by order of Government, is placed on the western bank of the *Ráma-gangá,* in 29° 7″ of latitude: the other or south *Cant'ha* is in the district of *Budayoon,* and is the head place of the *Purgunah* of *Kant* according to the *Ayin Acberi.** There is little doubt, but that the *Somá* or *Samí* is the *Isamus* of STRABO, the boundary of MENANDER's kingdom.†

THE beautiful *Vámá* was mentioned by MEGASTHENES, as a river falling into the *Ganges,* according to PLINY. This river consists of two branches, the western is called *Gángán,* according to the late surveys made by order of Government; the eastern branch is the *Ram-gangá,* and they unite about twenty miles to the south of *Rámpoor.* On the banks of the former lived the *Gangani* of PTOLEMY called *Tangani* in some copies.

THE next river is the *Gaurá, Gaurí* or *Gauráni.* There are many rivers so called, but it is doubtful, whether this was meant by the *Pauránics.* The inhabitants of the country call it so, this is sufficient authority, and it is probably the *Agoranis* of MEGASTHENES.

THE *Gomatí,* or *Vásishtí* river, is called in the spoken dialects *Gumtí.* About fifty miles above *Lucknow,* it divides into two branches, which unite again below *Jounpoor.* The eastern branch retains the name of *Gumti;* the western branch is called *Sambu* and *Suctí,* and in the spoken dialects

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* *Ayin Acberi,* Vol. 2d *Tucseem Jumma,* p. 84.

† STRABO Lib. 11, p. 516.

Sye, because it abounds with small shells. This is really the case, as I have repeatedly observed, whilst surveying, or travelling along its banks. They are all fossile, small and imbedded in its banks, and appear here and there, when laid bare by the encroachments of the river. They consist chiefly of small cockles and periwinkles. Many of them look fresh, the rest are more or less decayed, and they are all empty. I know several other rivers so called, and for the same reason. In the spoken dialects, their name is pronounced *Sye* as here, *Soy* and *Sui*, at other places, from the *Sanscrit Śucti*. This river is not mentioned in any *Sanscrit* book, that I ever saw, but I take it to be the *Sambus* of MEGASTHENES.

THE next river is the *Sarayu*, called also *Devicá*, and *Gharghara*; in the spoken dialects *Sarju*, *Devá*, *Dehá* and *Ghághrá*. The *Pauráńics* consider these three denominations, as belonging to the same river, The natives here are of a different opinion; they say that *Dewá* and *Ghághrá* are the names of the main stream, and the *Sarju* a different river as represented in Major RENNELL's maps. The *Sarju* comes from the mountains to the eastward of the *Dewá*, passes by *Baraich*, and joins the *Dewá* above *Ayodhyá* or *Oude*, and then separating from it, below that town, it crosses over to the other side, that is to say to the westward of it, and falls into the *Ganges*, at *Bhrigurásrama*, in the spoken dialects *Bágrásan*. In the *Cshétra-samása* it is declared, that the *Gharghara* is the true and real *Sarayu*, and that it is called *Mahá-sarayu* or great *Sarayu*, and the other is the little *Sarayu*. According to the above Geographical Treatise, the *Sarayu* is also called *Prema-báhiní*, or the friendly stream. Towards the west it sends a branch called in the

Purâńas, Tamasí, and in the spoken dialects, and in the maps *Tonsa:* it is a most holy stream, and joins the lesser *Sarayu* in the lower parts of its course.

It is omitted by Ptolemy, but it is the large river called by Megasthenes, *Commenases,* or the *Comaunish* river, because it comes from the country of *Comaunh,* called also *Almorah.* It is called *Oxdanes* by Artemidorus, as cited by Strabo, because it flows by the town, and through the country of *Oude,* called *Oëta* by the poet Nonnus.

The *Gharghara* is called *Gorgoris* by the Anonymous of Ravenna: for thus I read, instead of *Torgoris,* as the original documents were in the *Greek* language, in which there is very little difference between the letters T and *Greek* Γ. The *Ráva* or noisy river, is mentioned in the lists of countries in the *Puráńas,* otherwise it is but little known. In a derivative form, it becomes *Rávatí,* and in the spoken dialects *Rábtí* and *Rāptí.*

The *Gand'ací* or *Gand'acávati,* is called *Gandac* in the spoken dialects, and it is the *Condochates* of Megasthenes. This river is left out by Ptolemy; but it is obvious, at least to me, that he had documents about it and the *Sarayu,* which, either he did not well understand, or were very defective. All rivers to the north of the *Ganges* flow in general towards the south, declining more or less toward the east. Here Ptolemy has a river, which, according to him, flows directly towards the south-west, and he has very properly bestowed no name upon it. What is remarkable is that the source of this imaginary river is really that of the *Gand'ací,* and its confluence with the *Ganges* is that of the *Dewá.* On

its banks he has a town called *Cassida*, the *Sanscrit* name of which is *Cushadhá*, or *Cuśadyá*, the same with *Oude*; and; as it were to complete the sum of blunders, he has placed *Canogiza* or *Canoge* on its banks. According to PTOLEMY, the source of this river is in the northern hills, at a place, which he calls *Sêlámpura*, (as it is written and accentuated in the *Greek* original), at the foot of mount *Bepyrrhus*, so called from numerous passes through it and called to this day *Bhimpheri*, synonymous with *Bhay-pheri* or the tremendous passes, as we have seen before. *Selampoor*, is really a *Sanscrit* name of a place, *Śailapura*, or *Śailampur*, for both are grammatical, and are synonymous with *Śailagrám*, and the obvious meaning, and we may say the only one of both, is the town of *Śaila*, which signifies a rocky hill.

ENTHUSIASTS, have endeavoured to frame etymologies suitable to the rank, and dignity of this stone, which is a deity, and is god in its own right; for it is VISHNU: but they are rejected by sober and dispassionate *Pandits*, as too far fetched, and sometimes ridiculous. The name of this stone is written *Śálagrám*, *Śailagrám*, *Śaila-chacra*, and *Gandací-Śilá*. People, who go in search of the *Śálagrám*, travel as far as a place called *Tháccá-cote*, at the entrance nearly of the snowy mountains. To the south of it is a village, where they stop, and procure provisions. This village was probably called *Śailapur* or *Śailagrám*, from its situation near a *Śaila* or rocky hill, and from it this famous stone was denominated *Śailagrám*, as well as the river. *Tháccá* is mentioned in ARROWSMITH's map.

THE origin of this rocky hill is connected with a most strange legend, which I shall give in the abstract. VISHNU, unwilling to subject himself to the dreaded power, and influence, of the ruler of the planet SATURN and having no time to lose, was obliged to have recourse to his *Máyá*, or illusive powers, which are very great, and he suddenly became a rocky mountain. This is called *Śaila-máyá, of a rocky mountain the illusive form:* but SATURN soon found him out, and in the shape of a worm, forced himself through, gnawing every part of this illusive body. For one year of SATURN was VISHNU thus tormented, and through pain and vexation, he sweated most profusely, as may be supposed, particularly about the temples, from which issued two copious streams the *Crishna* or black, and the *Swéta-Gand'ací* or white *Gand'ací*; the one to the east, and the other to the west. After one revolution of SATURN, VISHNU, resumed his own shape, and ordered this stone to be worshipped, which of course derives its divine right from itself, without any previous consecration, as usual in all countries in which images are worshipped.

THERE are four stones, which are styled *Śaila-máyá* and are accordingly worshipped, whenever they are found. The first, is the *Śaila,* or stone just mentioned; the second, which is found abundantly in the river *Sońa,* is a figured stone, of a reddish colour, with a supposed figure of GAŃÉŚA, in the shape of an elephant, and commonly called *Gańéśa-cá-pát'har:* the third, is found in the *Narmmadá*; and the fourth, is a single stone or rock, which is the *Śaila-máyá,* of the third part of the bow of PARAŚU-RÁMA, after it had been broken by RÁMA-CHANDRA. It is still to be seen,

about seven *Cos* to the N. E. of *Janaca-pura* in *Taira-bhucta*, at a place called *Dhanucá-gráma*, or the village of the bow, occasionally called *Śaila-máyá-pur*, or *gráma*, according to the *Bhúvana-cośa*.

THE river *Gandacá* is so called because it proceeds from a mountain of that name. The people of *Naypála* call it *Cundací*, because it proceeds from the *Cunda-sthala* or the two cavities, or depressions of the temples of VISHNU, in the shape of a mountain, as I observed before.

IT is also called *Śala-gráma*, because of the stone of that name found in its bed. Another name for it is *Náráyaní*, because VISHNU or NÁRÁYANA abides in its waters, in the shape of the above stone.

THERE is a place, near *Janaça-pura*, which, as I observed before, is called *Śaila-máyá-pura* or *Saila-máyá-gráma*, and which becomes *Śaila-pura*, or *Śaila-gráma*, in the spoken dialects.*

SOME believe the *Śaila-grám* to be the eagle stone: if so it is not a new idea; for MATTHIOLUS, who lived I believe towards the latter end of the fifteenth century, says, that eagles do keep most carefully such a stone by them, and that, for this purpose, they travel to *India* in order to procure it. For without it the eggs in their nests would infallibly rot and be spoiled.

* IN the original MS. these words are written *Śála-máyá*, *Śaii-pura* and *Śáli-gráma*, that is to say, they have adopted the pronunciation of these words, such as it is in the spoken dialects. This is occasionally the case in geographical books in the *Sanscrit* language.

The next river is the *Bágmatí* or *Bángmatí*, that is to say full of noises and sounds. According to the *Himávat-c'hańd́a*, a section of the *Scanda-puráńa*, it comes from two springs in the skirts of the peak of Śiva. The eastern spring is the *Bágmatí*, and the western is called after *Harińeśwara* or *Harińeśa*, or the lord in the shape of an antelope. We read in the above section, that Śiva once thought proper to withdraw from the busy scenes of the world, and to live incognito in the shape of an ugly and deformed male antelope, that he might not be recognised by his wife, and by the gods, who, he knew would immediately go in search of him; as he was one of the three grand agents of the world. He was not mistaken; for 10,000 years of the gods, they searched for him all over the world, but in vain. His lubricity at last led to the discovery; for some of the gods took particular notice of the behaviour of an ugly male antelope, and they wisely concluded, that it was Śiva himself in that shape. Since that time Śiva is worshipped along the banks of the *Bágmatí*, under the title of *Harińeśwara*, or *Harińeśa*. The peak we mentioned before, is called to this day, according to Colonel Kirkpatrick, *Sheopoory*, the village or abode of Śiva or Seo. The pool, where he and his female friend used to allay their thirst, is called in the above *Puráńa*, *Mrigaśringodaca*, or *Harińaśringodaca*, or the water of the peak of the antelope, meaning Śiva in that shape. The western branch again flows into the *Bágmatí*; and I believe, that it once communicated its name *Harińeśi* to that river; and similar instances occur occasionally in *India*. Hence I suppose that it is the *Erineses* of Megasthenes, who besides says, that it ran into the *Ganges*, through the country of the *Mathæ*. This country is that of *Tirhut*, called also in *Sanscrit Maitha*, and *Maithila* from a *Rájá*, whose

father was called MIT'HÁ, and from him the son was called, in a derivative form, MAIT'HÁ and MAIT'HILÁ

THE next river is the *Camalá*, which retains its ancient name. The town of *Dwára-bhangá*, was originally on its banks, according to the *Bhúvana-cośa*. It was formerly a very extensive town with a fort built at a very early period. What was its original name is unknown: for *Dwára-bhangá*, signifies that the gate, either of the fort, or of the palace of the *Rájá*, had been destroyed, probably by a sudden overflowing of the river *Camalá*. It was repeatedly destroyed, during the wars of the natives with the *Muselmans*. It is now a small town, and the palace of the *Rajás* is no longer on the banks of the *Camalá*, but on the *Bacayá*, called in the maps *Buckiah*, a little to the westward of the old site of the town. It appears to me, that the river *Camalá*, was from the town being on its banks called the *Dwára-bhangá* river, and synonymous with *Dwára-báhá*. It is then the river *Tiberoboas* and *Taberuncus* for *Tabero-bancus*, mentioned in an account of the *Brachmans* by a certain *Palladius*, who wrote in the latter end of the fourth century. The name of this town is written *Dwára-bhanjá* and *Dwára-bhangá*, and also *Dara-bhangá*, and it is the *Durbungah* of the maps, and they all signify that the gate or door, had been broken down or carried away. In scripture likewise the gate of a town or of a palace was no insignificant building: there were held public meetings, and it was also a court of justice. On the banks of the *Camalá* was the native country of *Calanus*; for it is obvious from the above account, that with regard to persons travelling from the west, this river was to the eastward of the *Ganges*. It appears also that the country on its banks

was chiefly inhabited by *Brahmens*, or at least, that they were in great numbers there; and this is very true of *Tirhut*. On the *Divya-nadí* or divine river, but more generally called the little *Gand'ací* is *Púshá-grám*, or the town of the sun in his character of the nourisher. It is called also *Púshá-ghátí*; and the founder was a worshipper of the sun. The inhabitants are *Bhúmiháras* or husbandmen, and are very fond of horses. On the seventh of the month of *Ágraháyana*, they worship their horses. This place was, it appears, famous at an early period for the breeding of horses, and there is now one of the Company's studs: the place is generally called *Poossáh*. To the S. W. of it is the river *Núná*, which, having incurred the sun's displeasure, was cursed by him, and its waters became poisonous.

THE *Caus'ici* comes next and is a large and famous river commonly called *Cuśá* and *Cuśí*. It is formed by the junction of seven large streams, between the two first ranges. They are all called *Cuśí*, with an epithet peculiar to every one of them. The main branch is said to come from the hermitage of the sage CAUSICA OR VIS'WA'MITRA, which place with a village in its vicinity is called *Cuśagráma*, or *Cus'agánh*, and this river *Cuśa* or *Cauśa* is the *Cosoagus* or *Cosoagon*, in the objective case, mentioned by MEGASTHENES.

THE next is the *Báhudá*, called also *Mahodá* in the *Matsya-purán'a*. In the list of rivers in the *Mahá-Bhárata*, we read *Báhudá Mahá-nadí*. These denominations imply, many waters, great waters or the great river.

IN the *Tricand'a-cos'a* it is said to be called also *Śaita-Váhiní*, or the white river. Its present name is *Dhabalá* or *Dhabalí* which is also a

Sanscrit denomination of the same import. Another name for it is *Arjjuní*, synonymous with *Dhabalí*. It consists of two branches, the greater, and the lesser. The greater is simply called the *Mahá-nada*, and the lesser the *Dhabalí* river. This, I suppose, to be the *Sito-catis* of MEGASTHENES, from the *Sanscrit Sita-cantí*, to be pronounced *Sito-cantí* or nearly so, and which signifies the river with a white resplendence, or shining white. This river, and its western branch, are mentioned in the *Cshétra-samása*, where the author describing the country of *Ásáma*, and *Cáma-rúpa*, proceeds westward as far as the *Tístá*, and says, that the next river is the *Sita-prabhá*, brought from *Himálaya* by SAHA'-DEVA, and the next is the *Sitá* brought from the hills by BRAHMA'. *Sita-prabhá* signifies shining white, and is the same with *Sita-cantí*, or *Mahá-nadí*. The *Sita* or white river, is obviously the *Dhabalí*. This last was probably the original name, as it is still current among the natives.

PTOLEMY mentions this river, but without any name; otherwise its course is tolerably well delineated. He makes it fall into the western branch of the *Ganges*, because he was unacquainted with the eastern one, or the *Padmá*. He places its confluence between *Tondota*, and *Celydna*. *Tondota* is from the *Sanscrit Tand'á-hat't'*, or market place of *Tand'á*, which still exists. *Celydna* is from *Ciritná* or *Cilitná-deví*, worshipped at *Cirit-cona*, near *Moorshedabad*.*

THROUGH an obvious mistake in the longitude of the confluence, he makes it protrude a great way to the westward of the two last places.

* ERRONEOUSLY written *Terete-coonah* by Major RENNELL, in his beautiful map of the island of *Cossim-bazar*.

THE next river is the *Icshumatí* so called, because the adjacent country abounds with *Icshu* or sugar-cane. It is also called in the *Puránas* *Tritiyá,* because it divides into three branches or streams, in *Sanscrit* *Tri-srotá,* as it is repeatedly called in the *Cshétra-samása.* In the spoken dialects the letter R is invariably left out, in the two words, which form this compound. We must say of course *Tisotá,* from which comes *Tistá* its present name.

THE first or western branch is called *Purána-báhá,* or the old stream, and in the maps *Purnábahá.* The middle branch is named *Atreyí,* in the maps *Atrí:* the third or easternmost, is still called the *Tistá.* It springs from the main body, a little above *Sahib-gunge,* passes to the north of *Rung-poor,* and falls into the *Brahma-putra.*

PTOLEMY has noticed this river, and, with a considerable degree of accuracy, he has delineated the relative situation of what he supposed to be its source, with regard to that of the *Mahá-nadí,* as may be seen by comparing it with that part of Major RENNELL's atlas, in which these two rivers are represented, as coming out of the hills, with a ridge between them, as in PTOLEMY's map.

OUR author has left out the first and second branches, and has carried the whole body of the river at once, through the third branch into the *Brahma-putra,* which he calls *Daonas,* and this name he has also bestowed on the *Tista.*

THE *Icshumatí* is the *Oxymatis* of MEGASTHENES, for thus we should read instead of *Oxymagis;* the same substitution of Γ for T having taken place, that was noticed in a former instance. It is also the *Hypobarus* of CTESIAS, who says, that it is a river in *India* about two furlongs broad, and that its name in *Hindí,* signifies, *producing every thing that is good,* and, that during thirty days, it produces amber. A few lines after he says, that this amber proceeds from trees called *Sipachora.* This word is variously written in different MSS. Some read *Siptachora,* and PLINY has *Aphytacora** which, says he, signifies great sweetness, or very sweet. This last is the true reading; for it is obviously derived from the *Sanscrit Mishtácara* to be pronounced in the spoken dialects *Mitácora,* and which signifies very sweet; from *Mishta* sweet, and *Acara,* which implies excellence, excellently sweet. This amber is the common sugar, of a light amber colour, transparent, and in crystals before it is throughly refined.

THE river *Hyparchos,* called *Hypobarus* by PLINY, *ferens omnia bona,* producing every thing that is good, is from the *Sanscrit Sarva-vara, every thing good,* to be pronounced *Sabobara,* for they say *Sab* or *Sub* for *Sarva, all.* There is a small river of that name mentioned in the *Scanda-puráńa,*† which falls into the *Bágmatí.* It is called *Sarraricá* from *Sarva-vara,* and in a derivative form *Sarvaricá* or *Sarbarica,* producing every thing that is good. *Hypobarus* and *Hyparchos* are obviously

* PLINY Lib. 37. Cap. 2.

† SECTION of the *Himavat-c'handa.*

corruptions from *Subbara* and *Subbáricá*, for the letter H is often substituted to the letter S; thus in *Sanscrit* we have *Septa* seven, *Septem* in *Latin*, *Hepta* in *Greek* and *Heft* in *Persian*. Another name for this river, is *Gud'a*, because the country on its banks, produces abundantly *Gud'a* or raw sugar.

CARATOYÁ a sacred stream in the north of *Bengal*. At the wedding of ŚIVA and PÁRVATÍ, the water, which was poured upon their hands, fell to the ground, and became a river called *Cara-toyá* from *Cara* the hand, and *Toya* water. It is the *Currátyá* of the maps.

LET us now pass to the *Brahma-putra* or *Brahma-tanaya*, that is to say the son of BRAHMÁ, or rather his efflux. The account of this river, and of its various names is somewhat intricate, but above all its strange origin, which cannot well be passed unnoticed. It is to be found in several *Puráńas*, but the *Cál'ca* is the most explicit on the subject; and I shall give it here in the abstract.

BRAHMÁ, in the course of his travels, riding upon a goose, passed by the hermitage of the sage SANTANU, who was gone into the adjacent groves, and his wife, the beautiful and virtuous, AMOGHÁ was alone. Struck with her beauty, he made proposals, which were rejected with indignation, and AMOGHÁ threatened to curse him.

BRAHMÁ, who was disguised like a holy mendicant, began to tremble, and went away: however before he turned round, his efflux fell to the

ground; at the door of the hermitage. The efflux is described, as *Hát'aca* like gold, *Cara-hát'aca,* radiant and shining like gold, which is the colour of BRAHMÁ; it is always in motion like quicksilver. On SANTANU's return AMOGHÁ did not fail to acquaint him with BRAHMÁ's behaviour: he gave due praise to her virtue, and resolution; but observed, at the same time, that with regard to a person of such a high rank as BRAHMÁ, who is the first of beings in the world, she might have complied with his wishes, without any impropriety. This is no new idea; however AMOGHÁ reprobated this doctrine with indignation. I shall pass over, how this efflux was conveyed into her womb, by her husband. The NILE was also the efflux of OSIRIS, and probably the legend about it was equally obscene and filthy. In due time she was delivered of a fine boy, amidst a vast quantity of water, and who was really the son of BRAHMÁ, and exactly like him. Then SANTANU made a *Cund'a* or hole like a cup, and put the child and waters into it. The waters soon worked their way below, to the depth of five *Yojans* or forty miles nearly, and as far as *Pátál,* or the infernal regions. This *Cund'a* or small circular pond or lake, is called *Brahmá-cund'a,* and the river issuing from it, *Brahmá-putra,* the son of BRAHMÁ. The water in it is in a constant motion, always violently agitated, as may be supposed; and wonders are related of this place.

FROM this pool issues a stream, which forces its way, through the famous chasm, and pass of *Prabhu-cut'hára,* and rushes through the valley of *Ásáma.* It receives from the north the *Lohitá,* which flows through the country of *Tibet,* then through *Ásáma* and *Bengal.*

THIS pool is occasionally mentioned in the *Purán'as*, and always placed at the extremities of the east, near the *Udaya*, or mountains of the rising sun.

IN the *Ambicá-c'hand'a* it is said, that the sun performs there his ablutions, before he appears above the horizon. It is called *Sádya-hrada*, or the deep pool where the sun gets rid of his weariness, *Sád* or *Sádi*, after his fatiguing task. For this reason the *Brahmá-putra*, which comes out of this pool, is called *Gabhasti*, or the river of the sun.

IN the *Cshétra-samása*, it is said, that this pass is sixteen *Yojans*, or sixty-four *Cos* to the eastward of *God'agram*, or *Gorgán'h*: and the natives of *Asáma*, with several pilgrims, whom I have consulted, reckon the distance to be about seventy *Cos*; the difference in the present case is trifling, and the whole distance may be about 125 *British* miles.

FROM the above pass to the *Cund'a*, the journey is always performed in eight days, because travellers must keep together, on account of the inhabitants, who are savages, great thieves, and very cruel. There are fixed and regular stages, with several huts of the natives. The kings of *Asáma* are sometimes obliged to chastise them; but in general they contrive to secure the friendship, and protection of their chiefs, by trifling presents. The country is covered with extensive forests, with a few spots cleared up, with very little industry and skill. Tygers are very numerous, and very bold.

THE stages are very long, and every day's march is reckoned between nine and ten *Cos*, and as there is, I believe, a resting day, the whole distance may amount to about sixty-five *Cos* or 120 *British* miles.

THERE are in *Ásáma* two rivers called *Lohitá*, and both are mentioned in the *Matsya-puráńa*, in the list of rivers; the *Chacra-Lohitá* or greater *Lohitá*, and the *Cshudra-Lohitá*, or the lesser one. This last falls into the *Brahmá-putra* near *Yogi-gopá*, and is noticed in the *Bengal* Atlas. The original name of the greater *Lohitá* is *Samá* or *Sam*, and this is conformable to a passage in the *Varáha-mihira-sanhita*. There is a long list of countries, and among those situated in the eastern most parts of *India*, there is a *Samá-tat́a*, or country situated on the banks of the river *Samá*. This country of *Sam* is probably the country of SYM of HAITHO the *Armenian*, and it is part of *Tibet*, called *Tsan* by the *Chinese*.

THE *Samá* was afterward called the red river, from the following circumstance. The famous RÁMA, with the title of PARAŚU or PARŚU, having been ordered by his father to cut off his own mother's head, through fear of the paternal curse was obliged to obey. With his bloody *Paraśu* or *Parśu*, or cimetar in one hand, and the bleeding head of his mother in the other, he appeared before his father, who was surrounded by holy men, who were petrified with horror at this abominable sight. He then went to the *Brahmá-cuńd́a* to be expiated; his cimetar sticking fast to his hand all the way; he then washed it in the waters of the *Samá*, which became red and bloody, or *Lohitá*. The cimetar then fell to the ground, and with it he cleft the adjacent mountains, and opened a passage for himself

to the *Cuńd'a*, and also for the waters of the *Brahmá-putra;* he then flung the fatal instrument into the *Cuńd'a.* The cleft is called to this day *Prabhu-Cut'hára*, because it was made with a mighty *Cut'hára*, or cimetar. This is obviously the legend of PERSEUS, and the GORGON's head.

THE *Brahmá-putra*, is also called *Hrádiní*, as I observed in a former Essay on the Geography of the *Puráńas.* This word, sometimes pronounced *Hládiní*, signifies in *Sanscrit* a deep and large river, from *Hrĭda*, to be pronounced *Hrada* or nearly so, and from which comes *Hradána* and *Hrádiní.* In the list of rivers in the *Padma-puráńa*, it is called *Hrádya* or *Hrádyan*, and its mouth is called by PTOLEMY the *Airradôn Ostium*, or the mouth of the river *Hrádan:* and according to him, another name for it was *Antiboli*, from a town of that name, called also by PLINY *Antomela*, in *Sanscrit*, *Hasti-malla*, in the spoken dialects *Hátti-malla*, now *Feringy-bazar* to the S. E. of *D'hácca.*

EL EDRISSI says, that in the *Khamdan*, which joins the *Ganges*,* there was a *Triśula*, or trident, firmly fixed in the bed of the river. It was of iron, had three sharp prongs, and rose about ten cubits above the surface of the water, and says our author, its name, in the language of *India*, was *Barsciul*, or in *Sanscrit Vara* or *Bara-śúla*, the most excellent trident. Near this iron tree, was a man reading the praise of this river, and saying, "O thou, who abundantly bestowest blessings; thou art the path leading "to paradise; thou flowest from sources in heaven, the road to which thou

* P. 69 & 70.

"pointest out to mankind: happy the man who ascends this tree, and "throws himself into the river;" when, some one of the hearers, moved by these words, ascends the tree, and jumps into the river, and is drowned, whilst the spectators wish him the eternal joys of paradise. This is really in the style of the *Pauránics;* and though suicide is forbidden in general, yet there are privileged places, where it is meritorious to kill one self.

ACCORDING to RA'MES'WARA,* this place is in *Ásáma,* and its name is *Vis'va-nát'ha,* the place of the lord of the world, or MAHA'-DE'VA: I find it is well known to natives of the eastern parts of this country, and is said by them to be eight days to the east of *Goda-gráma,* and about two east of *Cáli-vára,* in the spoken dialects *Calyá-bára,* a strong place on the river. It is a small rock at the confluence of another river with the *Brahmá-putra,* with the *Linga* or *Súl* of MAHA'-DE'VA upon it, and a small temple erected there by a *Rájá,* above 300 years ago. According to RA'MES'WARA, this place of worship is not mentioned in the *Purán'as,* but only in some *Tantras,* and more particularly in the *Yogini-Tantra.*

IT appears from the above author's account, that some people visited this place with a view to put an end to their own lives there, and others out of religious motives only, to obtain certain benefits. But even this last was attended with much danger, for it was necessary, it seems, to swim or wade in going, and coming back from the rock, and in the mean time there were *Jala-manushas* ready to devour the pilgrims, whom they could

* IN his Commentary on the *Mahá-Bhárat.*

catch. *Jala-manusha* literally signifies watermen; however, it is never used in that sense; but it implies people, who in a compound shape of men, and of sea or river monsters, devour men and all living creatures, that come within their reach.

Máyá-batu was a king, who went to worship at *Viśva-náth*, and having entered the water, he saw three alligators, who wanted to devour him. They were then tearing the body of the *Rájá* of *Gaja-pur* in *Mohura-bánja*. Máyá-batu dived into the water, and effected his escape to the shore. There was then the *Rájá* of *Mosanga* or *Áracan*, who was going to perform his ablutions, and who informed him, that these three alligators were originally three notorious gamblers, and cheats, living in the town of *Codaru*, near *Rájá-mahendra*.* They were obliged to leave the country, and to take refuge on board of a ship, that was just ready to sail to distant countries. A sudden storm from the *Malayan* mountains *in the peninsula* drove them northward (it should be S.E.) to the country of *Cirâta*, which is near *Párindra*, or the lion's country, or *Sinhapur*, not far from the lesser *China*. The ship was wrecked upon the magnet rocks, near the mouth of the *Chárí* river. The three gamblers were devoured by alligators, and were born again of them in that odious shape, and they remain still in the *Brahmá-putra*, round a hill in the middle of it. According to the natives, on the day of the *Aśocáshtami*, in the month of *Chaitra*, they sacrifice men, buffaloes, goats and all sorts of animals in great numbers, when these alligators spring up to receive the blood into their mouths, and devour the

* Probably the *Codura* of Ptolemy.

flesh, which is abandoned to them. Great rejoicings are made to celebrate the entrance of the *Brahmá-putra* into their country on that day, when PARAŚU-RÁMA with his cimetar cut a passage for its waters, through the eastern mountains. It is said however that human sacrifices, are no longer allowed at that place. The magnet or loadstone, is emphatically called *Mani*, or the jewel, besides which, it has in *Sanscrit* many other names, more scientific, and which will appear when I pass to the countries and islands in the *Indian* ocean. In this manner ARISTOTLE styles the magnet ἡ λίθος the *Mani* or jewel: for such is the meaning of λίθος, when of the feminine gender.

IN the *Chatur-varga-chintámani*, it is declared, that the *Daityas* having been once worsted by the gods, fled from before them: but finding no place of shelter, their counsellor *Śucráchárya* created an immense magnet like a mountain, which attracted the arrows of the gods, that were pointed with iron. INDRA perceiving this, struck the mountain with his thunder, and divided it into numberless splinters: some fell upon the land, some into the sea. One fell into the sea to the south-east of *Chat'tala* or *Chat't'gánh*, and this is the reason, that it is so difficult to get over that sea. We are acquainted with two splinters of that mountain; one near the mouth of the river of *Negrais*, and called by the natives *Mani*, and by us Diamond Island, which denominations are implicitly synonymous; for this jewel was known formerly in *Europe* under the name of Adamant, which originally signified a diamond. The *French* say to this day *Aimant*, not surely on account of its love of iron. These magnetic rocks, of which we are now

speaking are mentioned in the *Arabian Nights*, and in the *English* translations, they are called the rocks of adamant. The other splinter is near *Párindra*, or the lion's place in the lion's mouth, or strait of *Sincapur*.

THIS magnetic rock, or rather rocks, constitute the *Maniolæ* islands of PTOLEMY, which, he says, attracted the iron nails of every ship that passed that way. There were ten of them, and among the islands of *Sincapur*, there are about ten larger than the rest. Their name *Maniolæ* is obviously from *Mańi* in a derivative form *Mańi-yálá*, which is admissible in the present case.

EL EDRISSI, has placed such another splinter or rock, at the entrance of the red sea, and calls it *Mandeb*, which I take to be from the *Sanscrit* *Mańi-dwíp*, and in the spoken dialects *Mańi-díb*.

RÁMEŚWARA has confounded these two splinters into one, by placing the latter close to the shores of the country of *Cirát*, which does not extend beyond *Cape Negrais*. The trident of the lord of the world is certainly *Vara-śúla*, *Pra-śúla* and *Srí-śúla*, which are denominations implying, excellence and power. The rock on which it stood was of course *Vara-śila*, *Para-śila* and *Srí-śila*, or the most excellent, and blessed rock, and the river in which it stood was once so called probably, at first by favourite poets, who sang the praises of MAHÁ-DÉVA, and of his *linga*, not forgetting the rock, on which it stood, nor the river in which it was situated: for we find the *Brahmá-putra* called by *European* writers of the seventeenth century

Persilis, and *Sersilis*, in the easternmost parts of *Hindûstan*, and it is connected by them with the river *Lacshá* or *Lakyá*.*

In the long lists of rivers in the *Mahá-bhárat* and *Padma-purán'a*, the *Brahmá-putra* is called *Antá-s'ila*, or the river of the rock of our latter end; alluding to the above rock.

With regard to these *Jala-manushas*, it is to be observed, that in general the *Hindús* believe, that all living beings originate from an atomlike germ endued virtually with life; but inert till placed in a proper medium; when it becomes actually a *punctum saliens* or an embryo. It is indivisible, and cannot be destroyed by any means whatever; but will remain till the end of the world. When a man dies, his body restores to the earth, and to the other elements, all that augmentation of substance, which it had received from them; but the atomlike germ remains the same. The three gamblers, whom we mentioned before, having been devoured by three alligators, their germ of course remained undigested, and unhurt, and soon after they were naturally conveyed into the wombs of females.

This atomlike germ is called in *Sanscrit Átibáhica*, and is mentioned in the *Garud'a-purán'a*.† It is called also *Váyavíyam*, because it goes faster than the wind, and I am assured, that it is mentioned in the *Védanta*:‡

* Modern Univers. History, Vol. 5th. p. 279. See also Edward Terry and others.

† Section of the *Préta-c'hand'a*.

‡ *Vedanta-dars'ana*, and in the *Atma-tatwánu-sandhána*.

they say, that it is exactly the sixth part of these atoms, which we see moving in the rays of the sun, when admitted into a dark room, through a small aperture. Its situation is above the nose inwardly, and between the eyebrows. However, some place it, either in the right thumb or in the right toe. *Muselmans* in *Arabia* suppose this germ to be the sesamoid bone of the first phalanx of the great toe.*

YAMA cannot inflict any punishment on the ÁTIBÁHICA, unless when united to the *Pind'a-déha*, for otherwise it is susceptible neither of pain, nor pleasure. I am told, that in the *Bhágavata*, it is considered as the same with the LINGA-S'ARÍRA: and others assert, that it is really the *Yoga-déha* of the LAMAS in *Thibet*. Some schools, either reject entirely, these idle notions, or substitute others of their own.

CTESIAS mentions wild men living in the waters of the river *Gaita* in *India*, in some part of its course, and from the context, this was in the eastern-most parts of that country. *Gaita* is perhaps for *Khatai*, another name, for the *Brahmá-putra*, because it was supposed to come from the immense country of *Khatai*.† PALLADIUS in his account of the *Brahmens*, says, that there were in the *Ganges*, dragons seventy cubits long, besides an animal called *Odonto*, who could swallow a whole elephant, and was so much dreaded, that no body durst cross that river, only at the time of the year, when the *Brahmens* visited their wives, who lived on the other side, for, dur-

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* SEE *French* Encyclopedia, v. Alfadara a magical term in that country.

† *AYIN ACBERI*, Vol. 2d. p. 8, &c.

ing that season, the monster was never seen. PALLADIUS supposes this river to be the *Ganges*, which seems to have been the limit of his geographical knowledge towards the east, but it was more probably the *Brahmá-putra*. The denominations of *Par-silis* or *Ser-silis* are now unknown in *India*, as well as that of *Khamdan* mentioned by EL EDRISSI, who says, that it is a large river, which comes from *China*, and falls into the *Ganges*. There is no doubt however, that at an early period it was current in *India*, for it is the *Cainas* of PLINY, and the *Doanas* or *Daonas* of PTOLEMY. These two words, being joined together, make *Cain-Doanas*. In *Sanscrit Cáyan-dhu*, and in a derivative form, *Cáyan-dhava* or *Cáyan-dhau*, *Cáyan-dhauní* or *dhauná* and *Cáyan-dhuní*, would signify the river of *Cáya* or *Brahmá*, and of course it is another name for the *Brahmá-putra*, implying exactly the same thing. Now Dr. F. BUCHANAN says, that the western branch of the *Airávatí* is called *Kiayn-dwayn*, which, in the language of the *Burmán* empire, signifies the fountain of *Kiayn*, which comes nearly to the same thing.* The case obviously, at least to me, is, that these two rivers come from a country called *Kiayn* or *Cayan*, and the same with that called *Cáháng* in the *Alphab. Tibetanum*. It is described as an immense country between *China*, *Tibet*, *India*, *Pegu*, &c. It is annexed to *Tibet* and is to be pronounced *Cáhánh* or *Cá-ánh*.

EDWARD TERRY, and others I believe, say, that the *Sersilis* comes from the borders of *Canduana*, the capital of which is *Carha-tanka*. *Canduana* is unknown now, and is never mentioned in any book that I ever saw; but it

* *Asiatick Researches*, Vol. 5. p. 231.

goes by the name of its supposed capital *Cara-hát'aca.* It is mentioned twice in the *Máha-bhárata,* where it is called in the list of countries *Hát'aca* and *Cara-hát'aca.* In several lists of countries from the peninsula, and published by Dr. F. BUCHANAN, and in another from that country also, given to me by Colonel MACKENZIE, the country of *Cara-hát'aca* is mentioned. However it is absolutely unknown in this part of *India;* but I do not think that it was the name of city, but of the pool of BRAHMÁ, the water of which is declared, as we have seen before, to be *Hát'aca,* and *Cara-hát'aca.*

IN the list from *Ávâ* published by Dr. F. BUCHANAN* there is a country called *Kian-dan,* and that gentleman declares, that the *Kiayn-duan* comes from the country of the *Kiayn* tribe. According to the journal of the four *Chinese* merchants, in their way back from *Siam* to their native country, and inserted in DU HALDE's *China,* the river of *Siam* comes from the mountain or mountainous region of *Kyang-daw.* HAJI-KHALIFA mentions, in that very country, a river called also *Khamdan,* but he meant by it, it seems, the river of *Cambodia,* for he says, that the town of *Khancu,* was situated upon it. This is not true of the town, but may be of the country of that name. For AL BERGENDI says, that it was rather the name of the country, and that the town was called *Khatha,* and is probably the same place, with a fine harbour, called at present *Catanh,* with an island in front, and of the same name.† This harbour is no longer frequented, and even

* *Asiatick Researches,* Vol. 6. p. 227.

† D'HERBELOT ad voc. *Khancou.*

hardly known. However it is probably the *Cattigara* of PTOLEMY, and the *Caitaghora* of EL EDRISSI, the fort and town of *Catanh*.

THIS country of *Cayan* or *Cayan-dhu* is mentioned by M. POLO, with a river called *Brius*, which is the *Brahmá-putra*. This region, says he, is to the west of *Carayan*, and an extensive country. As M. POLO speaks of these countries from report only, he is generally inaccurate, and it is a difficult task to recognise the countries he speaks of, and to arrange them properly. Be this as it may, he says, that *Carayan* is eighteen days from the city of *Mien*, which is *Ává*, and that the three first days, you descend through frightful precipices. Mr. DE GUIGNES shews, that it was part of *Yunnan*,* and I beg leave to add, that it extended a great way towards the west, as far as the country of *Cayan-dhu*, on the eastern banks of the *Brahmá-putra*. It extends along the northern frontiers of *Maní-pur*, from which it is separated by a ridge of mountains, called *Carrun* to this day, according to Colonel SYMES.† To the west of *Carayan*, and of the *Corrun* hills, was the country called *Cayndu* by M. POLO, and which was bounded, towards the west, by the river *Brius*. This is the *Brahmá-putra*, which is often styled, if not called, the river *Biryyá*, because it is the efflux of BRAHMÁ, and this word is always pronounced in the east *Birjja*. The country to the north of *Ásáma*, on its banks is called *Bramasong* in the *Alphab. Tibet.*, and in the *Puráńas*, *Brahmá-tunga*, in the list of countries. It is called also *Bregiong* because it is on the banks of the river *Birjj* or *Birjyam*, in a

* HISTOIRE des Huns. Vol. 4. p. 176.

† EMBASSY to *Ává*, Vol. 1st. p. 181.

derivative form. The *Capucins*, who had a small convent in *Tacpu*, to the north of it, had some correspondence with the petty king of *Bregiong*.*

THIS *Brahmá-cuńd'a*, from which issues the *Brahmá-putra*, is the same which is called *Chiamay* by DE BARROS, and other *Portuguese* writers. DE BARROS calls the *Brahmá-putra* the *Caor* river, and says, that it comes from the lake *Chiamay*, and from thence it goes to the town of *Caor*, after which it was denominated, thence to *Sirote*, to *Camotay*, and afterwards into the sea. *Caor* is the famous town of *God'a*, or *Gaur* generally, called *Gorgánh*, that is to say, the town of *God'a*. *Sirote* is probably *Sarada* a famous place of worship mentioned in the *Cálicá-puráńa*, and *Camotay* is the place of CÁMÁCSHYA-DEVI, called also *Cámá-pít'ha*, or the seat of CÁMÁ-DEVI. The whole country is also called *Cámá-pít'ham*, pronounced formerly *Camptá* and *Camtá*.†

THIS is the country called *Pitan*, by some of our writers of the sixteenth and seventeenth centuries, and which was separated from *Candwanah*, by the river *Persilis* according to EDWARD TERRY, who says, that this river (which is the *Brahmá-putra*) comes from the country of *Gor*: and this is in some measure true for it passes through it, in its way into *Bengal*. The *Chiamay* lake was said to be 180 miles in circumference, which may be true of the country of *Sayammay* or *Chiamay*, noticed by

* RAPPRESENTAZIA de Padre *Cappuc.* Mission. della stata presente della mission delgran. *Thibet.* *Roma*, 1738; also *Alphab. Tibet.* p. 422 & 423.

† *AYIN ACBERI*, Vol. 2d. p. 5.

Dr. BUCHANAN.* ORTELIUS in his map of *Asia* in 1580, calls this lake *çaÿamaÿ*, with two dots on the letter Y, and with the cedilla, or dash under the letter C, and to be pronounced *Sayamay*, as it is writen by Dr. BUCHANAN; but in his map of *India*, he spells it *Chyamai*, which sounds exactly like *Chyamay* in *English*. He mentions also the country of *Camotay*, the towns of *Chirote* and *Caor*.

FOUR rivers are supposed to spring from this lake, but except the *Brahmá-putra*, the others must issue from it, through subterraneous channels. The *Pauránics* delight in such mystical communications, and they are really very numerous in *India*. But this sort of paradise, with four rivers issuing from it, is obviously taken from our sacred books. With the *Jews* we have one, the *Hindús* another: the people of *Tibet* have one of their own, and the nations beyond the *Brahmá-putra* claim very properly the same priviledge.

THE *Brahmá* or *Brahmí* river, another name for the *Brahmá-putra*, is called *Cáya*, one of the names of BRAHMÁ, hence the river of *Avá*, supposed to spring from the above lake, is called *Cay-pumo*, or the *Burmán Brahmá-putra*; for the *Burmán* country, is also called *Pummay* according to Dr. BUCHANAN, and *Puma-hang* by the four *Chinese* merchants, mentioned by DU HALDE. The two heads of the *Doanas*; and those of the two next rivers the *Dorias*, and the *Serus* or river of *Ává* in PTOLEMY's maps, do not correspond with the mouths, he has assigned to them on the sea shore. This mistake originates from the imperfect notions which he

* *Asiatick Researches*, Vol. 6. p. 226.

had of the geography of so remote a country, which he fashioned into a map according to some pre-conceived opinions, and an erroneous system of his own. The mouth of the *Brahmá-putra*, for instance, does not appear on the sea shore, even in our most modern maps, and the *Pauránics*, in their geographical diagrams, make the *Hrádiní* or *Brahmá-putrá*, with the *Pávaní* or *Ává* river to flow toward the S. E. The source of the eastern branch of the *Doanas*, or *Brahmá-putra*, is really at the *Brahmá-cuńd'a*, and thus far PTOLEMY was right. To the upper part of this river through *Tibet*, he properly gives the name of *Bautes* or *Bautisus*. *Bhoti-su*, in the language of *Tibet*, signifies the water or river of *Bhota*, the *Sanscrit* name of that country. He could not know however, what became of it beyond *Thogara* or *Tonker*. The next river is the *Meghanád* or *Megha-váhana*, in the spoken dialects *Meghwán*, and *Meghná*. It is a well known river, and the general drain of the waters of *Silhet*, and adjacent countries. It begins I believe, to be so called near *Azmarigunge*, below the junction of two considerable rivers, the great *Bacrá*, and the *Baleśwarí* from *Silhet*, and commonly called *Bowlee*. The original stream is the great *Bacrá*; which according to the *Cshétra-samása*, comes from the country of *Hed'amba*, now *Cachar* or *Cuspoor*, to the eastward of *Silhet*. It is remarkable, that the *Brahmá-putra*, on being joined by this inferior river, and of obscure origin, being from *Megha* or the clouds, loses its name at once. The *Megná*, now an immense river goes into the ocean, but, properly speaking, without joining the *Ganges*; though they approach very near to each other. But the mouths of the *Ganges* and of the *Brahmá-putra*, are so masked by large, and numerous islands of various sizes, that they are by no means obvious from the sea, like that of the western branch

of the *Ganges*. Yet there is no doubt that formerly they united their streams, and that they will again at some future period.

THE *Meghwán* is the *Magone* of MEGASTHENES, as cited by ARRIAN, as one of the rivers that fell into the *Ganges*.

THE next river is the *Dumurá* or *Dumburá*, for the letter M easily admits B and P after it. In the lower part of its course it is called the *Carmaphulli*, and falls into the sea at *Chátgánh*; but PTOLEMY has carried its mouth, and that of the *Doanas* into the gulf of *Siam*. According to the *Cshétra-samása*, it is the eastern boundary of *Traipura* or *Tippera*, and fourteen *Yojanas* or about 105 *British* miles from *Agratolá*, now *Núr-nágar*, and formerly the capital of that country. *Dumurá* is a very common name in *India*, and in the spoken dialects generally pronounced *Dumrí*, *Dumríyá*, *Dumroy*, &c. It is the river *Dorias* of PTOLEMY, for *Domrias*. He has placed its source in some country to the south of *Salhata* or *Silhet*, and he mentions two towns on its banks; *Pandassa* in the upper part of its course, but unknown; in the lower part *Rangiberi*, now *Rangámati* near *Chátgánh*, and *Reang* is the name of the country on its banks. On the lesser *Dumurá*, the river *Chingree* of the *Bengal* atlas, and near its source is a town called there *Reang*. *Rangámati* and *Ranga-báti* to be pronounced *Rangbari* imply nearly the same thing.

THE next river is the *Pávaní* from *Pavana*, which in lexicons, as in the *Amara-cósa*, becomes in a derivative form *Pavamán* or *Paumán*. I believe

it is so called because it flows through the country of *Pama-hang** or *Burmá*, which according to Dr. F. BUCHANAN is also called *Pummay*. Hence it is, that the first *Portuguese* writers, called one of the supposed branches of the *Cayan* river, flowing through the *Burmán* country, *Cay-pumo*, and by PLINY it is called *Pumas* or *Pumán*. The *Paurán'ics*, as usual searched for a *Sanscrit* origin for it, and derived it from *Pavana*, which signifies wind. In the *Cshétra-samása* it is called *Su-bhadrá*, or the beautiful and great river, The river *Brahmotárí*, says the author, flows by *Mani-pura*, and going toward the east, it falls into the *Su-bhadrá*. The *Pávaní* or *Paumán*, called also *Su-bhadrá*, is the *Airávatí*, which flows by *Amará-pura*. It forms the upper, or northern part of the river, which PTOLEMY calls *Serus*, the lower part of which is the *Menan*, which flows by *Siam*. The true spelling of the name of this river, and its *Sanscrit* origin, if derived from that language, are rather obscure, as it is not mentioned in any book, that I have seen. I suspect however, that it is hinted in the *Garud'a-purán'a*, in a curious route performed by the souls of all those, who die, at least, in this part of the world. These souls, having assumed a pygmy form, no bigger than the thumb, which is compleated in twelve days after the decease, on the thirteenth are seized by the servants of YAMA, and carried through the air to *Yama-puri* or *Yama-cot'a*, on the high grounds in the center of the *Malayan* peninsula, and called *Giam-cout (Jama-cot'a)* by *Muselman* writers. There they remain one month, and thence go by land to *Dharma-puri* in the N. W. quarter of the world, on the shores of the western ocean, there to be judged by YAMA, with the countenance of the

* DU HALDE's *China*, Vol. 1st. p. 63.

DHARMA-RÁJÁ or king of justice: for he has two countenances, one remains at *Dharma-puri*, and the other at *Yama-puri*. There are two roads, one for good men, called *Saumya* or beautiful, the other *Cashta-márga*, or the painful road: for now they travel on foot.

IN fifteen days they reach *Sauri-pur*, where rules JANGAMA with the dreadful countenance. When they see the town and its ruler, they are much afraid: and there they eat the funeral repast of the third *pacsha*, or of the first month and half, offered by their sons.

THENCE they proceed through dreadful forests, to *Várendra-nagara*: where they eat the funeral oblation of the second month, and receive some clothes, and then they set off for the next stage. The district of *Várendra* in *Bengal*, between *Gauda* and *D'hácá*, is well known.

OF the kingdom of *Jangama* we have some knowledge, and it is about half way between the *Malayan* peninsula and *Várendra*. Its name is written *Jangoma* or *Jangomay* by *European* writers, and it is a great way to the north of *Siam*. It has the *Laos* to the east, and the country of *Ává*, or the *Burmán* empire to the west. Its capital *Sauri*, still unknown to us, is upon a river called, I suppose after its name, *Saura* or *Sauri*.

PTOLEMY has delineated tolerably well, the two branches of the river of *Ává*, and the relative situation of two towns upon them, which still retain their ancient names, only they are transposed. These two towns are *Urathena*, and *Nardos* or *Nardon*; *Urathena* is *Rádhana*, the ancient

name of *Amará-pur*, and *Nardon* is *Nartenh* on the *Kayn-dween*.* For *Nardon* is a town according to PTOLEMY, and by no means the name of a well known plant, and which I believe does not grow in that country. He says, that it was situated in the country of *Rhandamar-cot'a*, literally, the fort of RANDAMAR; after which the whole country was denominated: but of the town itself he takes no notice whatever.

THE *Sanscrit* name of this country is *Cáśára*, and *Hed'amba* or *Hid'amba*; the king of which was killed by BHÍMA, who fell in love with his sister HID'AMBÁ, and remained with her a whole year. From this union, are descended the present kings of that country, who come occasionally to *Benares* to worship. HID'AMBA, and his subjects were cannibals, and he and his sister wanted very much to eat BHÍMA, as he was fat and plump, HID'AMBA was also called † *Run'd'a-mun'd'a*, because, whenever he could catch any unfortunate traveller, he made his body *Run'd'a* or headless; and also he made his head *Mun'd'a*, that is to say, he cut it off and separated it from the body; for it is customary with men-eaters to cut off the head imediately, and to throw it away. It was enough to call him RUN'D'A or the RUN'D'A-RÁJÁ, because this necessarily implies the other; but *Run'd'a-mun'd'a* is an alliteration, highly delightful in the ears of *Hindús*, who are great admirers of such a jingle of words. However, a field of battle though strewed, both with *Run'd'a* and *Mun'd'a*, is simply called *Run'd'ica*, instead of *Run'd'a-mun'd'ica*, because the beauty of the alliteration is entirely lost, by this compound assuming a derivative form. RUN'D'A

* EMBASSY to *Ává*, Vol. 1st. p. 180.

† COMMENTARY on the *Mahá-bhárata*, section the third.

was the name of every *Rájá* of *Hedambá* to the last, who was killed by BHÍMA, who for that reason, was, I believe, surnamed RUN'D'A-MÁRA, or he who killed RUN'D'A: thus the famous king DHUNDHA-MÁRA was so called, because he killed the *Daitya* DHUNDHU. *Run'd'a-mára-cot'a* signifies the fort of him, who killed RUN'D'A. RUN'D'A was a *Daitya*, and a native of *Sónit-pura*, near *Gwál-párá*, on the borders of *Ásáma*, and that place was the metropolis of the *Daityas* or devils, whilst the gods or followers of BRAHMÁ, lived to the westward of the *Brahmá-putra*. The country of the *Daityas*, extended from that river eastward, to the banks of the *Irávatí*, and was parcelled out amongst several chiefs; but he of *Hedambá*, conquered them all, and H[illegible] and VA[illegible] *Daityas*, who resided at *Sonit-pura*, were so much afraid of him, that they left their country, and fled to distant places; for he was remarkably fierce and cruel. His kingdom was very extensive, and was three months in extent from north to south.* PLINY calls the river of *Avá*, *Pumas* or *Puman*, in the objective case; and says, that many nations in that part of the country were called in general *Brachmanæ*, *it should be Barmánæ*. One is particularly noticed by him, "the *Macco-* "*calingæ*, with two rivers called *Pumas*, and *Cainas*; both navigable: " but the *Cainas* alone, says he, fall into the *Ganges*." It is therefore the *Cayana*, or *Brahmá-putra*. The *Maga-calingas* are the *Magas* or *Mugs*, living near the sea shore in *Chat'gánh*, and *Arácan*.

HAVING thus described the heads of such rivers toward the east, as were known to the *Pauránics*, let us now proceed to the sea shores.

* *Cshétra-samása*, section of HED'AMBA.

PTOLEMY says, that the easternmost branch of the *Ganges* was called *Antibole*, or *Airradon*. This last is from the *Sanscrit Hradána*, and is the name of the *Brahmá-putra*. *Antibole* was the name of a town situated at the confluence of several large rivers to the S. E. of *D'hácca*, and now called *Fringy-bazar*. It is the *Antomela* of PLINY, and its *Sanscrit* name is *Hasti-malla*, in the spoken dialects *Háthí-máliá*. In the *Swarodaya-máhátmya*, *Hasti-malla*, as well as the country about it, is called *Hasti-bandh*, because the elephants of the *Rájá* were picketted there, or in its vicinity. It was, says PLINY, situated at the confluence of five rivers, and on that account it is called *Panchanada-nagare* in the *Harivansa*.

THE next is the *Phaní* or serpent river: it is mentioned in the *Mahábhárat*, under the name of *Airávat*, a large sort of serpent. On its banks lived the famous ULUPÍ, daughter of AIRÁVAT, or PANNAGA, or the serpent king: from her, and ARJUNA, the *Pandwan*, are descended the present *Rájás* of *Trai-pura* or *Camillah*. This river is the *Fenny* of the maps.

LET us now pass to the *Carma-phullí*, or *Chaťgánh* river. It is mentioned in the *Scanda-puráńa*, in several *Tantras*, and Geographical Tracts. In the *Bhúvana-cośa*, it is declared, that it is so called, because there *Carma*, or good works do blossom and flourish most luxuriantly, so as to produce fruit most abundantly. In short, every thing on its bank flourishes in that manner, such as *Dharma*, or religious doctrine, *Carma* religious deeds, *Puńya* or righteousness: even the very spot or *gráma*, flowers in that wonderful manner; for *Chaťgráma* is called in the *Puráńas*, *Phulla-gráma*. *Chaťťa* is a royal *mat* spread under a tree, in those times of simplicity

of manners: *Paťťa*, or *Piťha*, any seat, with the addition of *Phulli*, implies a blessing to the royal *mat*, to the royal *seat*. This explanation of the meaning of *Carma-phullí* and *Chaťťa-grámа*, is in the *Bhúvana-cośa*.

IN the *Scanda-purána*,* the words *Paťťa* and *Chaťťa* are acknowledged, as the names of *Chatgánh*, but with another meaning. *Dévi*, having destroyed there, the *Daitya* MAHISHÁSURA; his bones, the flesh being rotten, appeared upon the ground like immense flag stones, or *Paťťana* in *Sanscrit*, and *Chaťťana* in *Hindí*. The right or southern point at the mouth of the river, is called *Pengui*, because it is towards *Pengu* or *Pegu*: the left or northern point, on the side on which the town is situated, is called to this day *Paťťana*. There can hardly be any doubt, in my humble opinion, but that this town is the *Pente-polis* of PTOLEMY, for *Paťťa*, or *Paťťan-phullí*, the flourishing seat.

THE *Carma-phullí* is also called, though rarely *Carńa-phullí*, and it is the *Carnabul* of the EDRISSI, who wrote about the year 1194: but that geographer has bestowed that name, rather upon the town of *Chatgánh*, because situated on its banks.

THE *Carma-phullí*, as I observed before, is called in the upper part of its course *Dumburá*, *Dumurá*, or *Dumríyá*: on its passing through the hills, it assumes the name of *Carma-phullí*: but its original name is *Bayulí* or

* SECTION of the bridge of RÁMA.

*Baypulá.** In the *Bhúvana-cośa*, it is declared, that it flows through the country of *Ári-rájya*, or kingdom of Ári, where it assumes the name of *Nábhí*, according to the *Cshétra-samása*, and is commonly called the *Náf*, and *Teke-náf*. This river is called in the *Bhúvana-cośa*, *Héma* or golden river, probably because it comes from the golden mountains, styled *Héma*, *Canchana*, *Canaca* &c., which signify gold. In general all the rivers of this country are considered as branches of the *Carma-phullí*, some are actually so, others are so only in a mystical sense, This accounts for the inland communications between the *Carma-phullí*, and the *Arácan* river, as delineated in former maps. It is not to be traced, as yet, beyond *Ro*[illegible] or *Rámu*, though it may exist still farther south. In the first map of the *Bengal* atlas, this inland communication by water is well delineated from *Chat gánh*, to *Chacoríyá*; and Mr. Bartholomew Plaisted, Marine Surveyor carries it as far as *Rámu*.† In the *Cshétra-samása*, it is asserted, that the river to the south of *Rámu*, about two *Yojanas*, or eight *Cos*, is an arm of the *Carma-phullí*, and the boundary of the *Barmá* country; or *Arácan*; and the author says, that there are in that country, five rivers or branches of the *Carma*, the *Ichhámatí*, which flows by *Rámuna* or *Rámu*; the *Śanc'há*, the *Sunkar* of the maps: the *Śrímatí*: the *Swarnáchari*, called in the spoken dialects, according to our author, *Sonáchari*, but these two are unknown to me. The last is the *Cesárá*, in the spoken dialects *Cach'hárá*, and on its banks is *Havila-dára-gráma*,

* *Cshétra-samása* and *Bhúvana-cośa*.

† See New Directions, &c. by Benjamin Lacam, p. 20. Mr. B. Plaisted, whilst surveying some parts of the *Sunderbunds*, was carried away by an alligator, which he mistook for the rotten trunk of a tree. This was written at the end of his survey, where he thus left off, in the Surveyor General's Office, where I saw it about 40 years ago.

commonly called *Ranguna,* which is inhabited by *Magas;* and is situated amongst hills; and from it this river is called *Havildára* in the maps.

The river we mentioned before, two *Yojanas* to the south of *Rámu* is called *Rajju,* which in *Sanscrit* signifies both a rope, and a bamboo. *Rajju* is also synonymous with *Guńa* and *Dáma;* which last is the name of several places on that coast. Perhaps these words imply, that there was either a cable, or a boom of bamboos lashed together, laid across the river. There the king of *Śonitpur, Naraca,* placed the *Linga* or *Phála* of Mahá-Déva, under the name of *Ádya-nátha* or *Ádi-nátha,* the primeval lord, *Lingam* and *Phallus.* In the *Bhúvana-cośa,* it is said, that this place was laid waste by the *Yavanas,* or *Musulmans.* Another name for it, was *Phalgunagār* or town of Phalguna, having been built by Arjuna, called also *Phalguna.* In the *Cshétra-samása,* it is said, that it was near a river, and that it was built by a man of that name, and it is, says our author, commonly called *Phanguna* or *Phalgun.* Another name for it, he adds, is *Phálgunagara,* and this, in my opinion, is the *Baracura* of Ptolemy. *Phalgun* is called *Palong* in the maps, with the epithet of *Burra* or the great, which might have been the case formerly.

To the south of the *Rajjoo,* about forty miles is the river *Nábhí,* vulgarly *Náf,* because it proceeds from the navel of a certain god, who resides amongst the hills. It is more generally called *Teke-náf,* and in official reports, made to Government, I understand that it is generally so called. *Teke-náf* implies, that it flows through the country of *Teké,* written in some *Sanscrit* books *Tecu,* and *Teceu,* to be pronounced *Tecoo* and *Tekyou.*

It is now the boundary of *Arácan;* and in some maps, it is called the *Dombac* river, from a place of that name situated on its banks. The *Sanscrit* name of *Arácan* is *Barmá, Barmán* and *Barmánaca* proper; by the people of *Pegu* it is called *Takain.* Dr. F. BUCHANAN* says, that *Thæk* is the name of a tribe, living on the eastern branch of the river *Naaf;* and who sent a colony to the upper parts of the *Carna-fulli;* and this circumstance is recorded in the *Bhúvana-cosa,* in the these words: "at "*Carcanduca,* in the woods, will come a TECU-RÁJÁ, who will abolish all "distinctions of casts; but NÁGÁRJUNA will destroy him." In the *Cshétra-samása,* it is called *Carcándu,* near the *Carna-phullí,* and its present name is *Cácundi,* says our author. It is also in the country of *Ce[illegible]a,* commonly called *Ceu* or *Ceuncá;* and its inhabitants *Chacr* or *Kookies.* A respectable native of *Rangoon,* who came some years ago to *Benares* with many persons of that country, informed me, that he had been at *Arácan,* and that he understood, that the bulk of the inhabitants were of a tribe called *Tek* or *Teké;* and from it the country was called *Tekain* or *Takain.* He suspected that *Tecain, Yecain* and *Recain,* might be the same name differently pronounced, and indeed Dr. BUCHANAN says, that indistinct articulation is fashionable through the *Burmán* empire, and the adjacent countries.

THE next river is the *Mahá-nadí* or great river, which flows by *Arácan.* There is *Síla* or *Saila-pattana,* or the stone city, the seat or throne of the *Maga Rájás.*

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* *Asiatick Researches,* Vol. VI. p. 229.

THERE in the *Mahá-nadí* is *Veńu-gartta*, or the bamboo fort; but the sea overflowing will destroy it, and leave in many places shoals, and sand banks. This is the second inundation of the sea, which will do so much mischief to the whole country. The first, it appears from our author, affected chiefly the shores of *Chat'gánh*. This bamboo fort, I suppose has been rebuilt more inland, for it still exists, and is mentioned in a *French* map by the Sr. ROBERT in the year 1751, where it is called *Fort de Bamboux*. In a sketch of the mouth of the river of *Arácan* by D'ANVILLE, it is inserted, but without a name. It is placed there about sixteen miles to N. E. of the pagoda, at the entrance of the river on the left side.

VENUGARTTA is literally a bamboo pit in *Sanscrit*, but in *Hindí* it is either *Veńu-gár* or *Veńu-gárá*: the first, signifies a bamboo fort; the second, a bamboo-pit, which last is hardly admissible. The town of *Arácan* may be called with great propriety the stone city, being surrounded by steep craggy rocks cut artificially like fortifications.

THE *Arácan* river, in the *Bhúvan-cośa*, is called *Mahá-nadí*, or the great river; but its real name among the natives is unknown. PTOLEMY calls it *Tocosanna*, the true pronunciation of which is, I believe *Teku-shán* or *Teke-shán*: and we have in that country the *Teke-náf*; the inhabitants of *Arácan* are of the *Tekeu* tribe, and the country is called *Takain*, and the word *shán* is certainly obvious in *Rau-shán* another name for *Arácan*, and I believe, that *Ru* or *Yu*, *Rai*, *Yai*, are the names of a tribe in that country: for, says Dr. BUCHANAN, what is written *Rœ*, is pronounced *Yœ* in that country. The meaning of *Shán* is unknown; but I take it to be an

honorable title. It is says Captain SYMES, a very comprehensive term, given to different nations, whether independent or not.* It appears to me that *Teku-shán*, was pronounced by the *Portuguese Touascan*, for *Teke-shán*, or *Tecwá-shán*, in a derivative form from *Tecu-shán*. *Portuguese* writers mention also another district called *Co-Dowascan*, which I suppose to be *Cu-Tecwá-shán*, and to allude to the invasion of the *Cu* or *Cuci* country by the *Thake* tribe, as mentioned by Dr. BUCHANAN. Mr. D'ANVILLE in his map of *India* of the year 1752, mentions four places in the district of *Chat'gánh*; three of which belong to *Arácan*: the fourth or *Cu-Tecwá-shán*, belongs to *Chat'gánh*; being situated in the upper parts of the *Ca[illegible]-phullí*. The three other places are *Towasca[illegible]*, or the town of *Arácan*: *Sundar* or the town of the moon, in the dialect of that country, and called *Vidhu* in the *Cshétra-samása*, synonymous with *Chandra* or *Sundar*, is some where near the *Teke-náf*: the last is *Soré*, probably the town of ZARA mentioned by *Portuguese* writers, as belonging to *Arácan*; its situation is unknown, but it is probably to the south of *Arácan*.

WITH *Portuguese* writers *Towascan* is not the name of a river but of a town, which, I conceive is no other then *Arácan*, the metropolis of the *Teke-shán* tribes. PTOLEMY places on the *Tocosanna* the metropolis of the country, and calls it *Tri-lingon*, a true *Sanscrit* appellation. Another name for it, says our author, was *Tri-glypton*, which is an attempt to render into *Greek*, the meaning of *Tri-linga* or *Trai-linga*, the three *Lingas* of MAHA'-DE'VA, and of which the *Tri-súl*, or trident is the emblem.

* EMBASSY to *Avá*, Vol. 2d. p. 258.

It is often represented by three perpendicular cuts, parallel to each other; and this in *Greek* is called *Tri-glypton*. *Árácan* is part of an extensive district called *Tri-pura* or *Trai-pura* in the *Puráńas*, or the three towns and townships, first, inhabited by three *Daityas*, the maternal uncles of RÁVANA. These three districts were *Camillá*, *Chaťťala* and *Barmánaca*, or *Raśáng*, to be pronounced *Ra-shánh* or nearly so; it is now *Árácan*. MAHÁ-DÉVA destroyed these three giants, and fixed his *Tri-śúl* in *Camillá*, which alone retains the name of *Tri-pura*, the two other districts having been wrested from the head *Rájá*. The kings of *Árácan* and of *Camillá*, were constantly striving for the mastery, and the former even conquered the greatest part of *Bengal*, hence, to this day, they assume the title of lords of the twelve *Bhúnïyás*, *Bhattis*, or principalities of *Bengal*. At such times *Árácan* was the metropolis of the *Trai-puras*, and of course it became the seat or place of the *Tri-linga*, or three fold energy of MAHÁ-DÉVA, the emblems of which are the *Tri-śúl*, and the three perpendicular cuts. PTOLEMY says, that in the country of *Tri-linga*, there were white ravens, white parrots and bearded cocks.

THE white parrot is the *Cácátwá;* white ravens are to be seen occasionally in *India*, as well as in *Europe*, and their appearance is considered in this country as most inauspicious. Some say, that this white colour might have been artificial, and the result of a certain liquid preparation, which after the removal of the old feathers is poured upon the new ones. The colour will last of course, as long as these feathers do; but will disappear with them, at the next moulting season. (*Muselmans* in this country very often dye their beards likewise.) The bearded cocks have, as it

were, a collar of reversed feathers, round the neck and throat, and there only, which gives it the appearence of a beard. These are found only in the houses of native princes, from whom I procured three or four; and am told that they come originally from the hills in the N. W. parts of *India*. We have also bearded eagles in *Europe*.

THE *Mahá-nadí*, or river of *Arácan* is the last on that coast, in our *Sanscrit* records, and the district of *Sandowy*, called also *Thayndwa* or *Saindwa* by DR. BUCHANAN, and declared by him and* Captain SYMES, to be the southernmost division of *Arácan*, is also the most southerly district of the empire of the followers of BRAHMÁ, or *India*, along that coast, ending in about eighteen degrees of latitude north. In the *Bhúvana-cosa*, it is called *Sandwípa*, but, I believe it should be *Sandwi*. In that district is a river, and a town called in modern maps *Sedoa* for *Saindwa*, and in PTOLEMY *Sadus* and *Sada*. Between this river and *Arácan*, there is another large one concealed behind the island of *Cheduba*, and the name of which is *Cátá-baidá* or *Cátá-baizá*. This is the river *Cata-beda* of PTOLEMY, which, it is true, he has placed erroneously to the north of *Arácan*; but, as it retains its name to this day among the natives, and as it is an uncommon one in that country, we can hardly be mistaken.

As that part of the country is very little frequented by seafaring people, the *Cátá-baidá* is not noticed in any map, or sea chart whatever. It was first brought to light by the late Mr. REUBEN BURROW an able Astronomer,

* *Asiatick Researches*, Vol. 6th. 199 and 201.

and who visited that part of the coast by order of government.* In the language of that county *Cátá* is a fort, and *Byeitzá* or *Baidzá* is the name of a tribe in that country.† Thus *Cátá-baizá* is *Fort baidzá*, and *Baidzá-Cátá* is the *Baizá-fort*.

THE island of *Cheduba*, opposite to this river, is called very properly *Bazacata* by PTOLEMY, and Dr. BUCHANAN informs us, that the letters T, D, Th. and S, Z, are almost used indiscriminately in that country, where even indistinct pronunciation is fashionable.

IN the countries of *Chattála*, and *Barmánaca*, RÁMA-CHANDRA began his first bridge, in his intended expedition against RÁVANA. The abutment took up the whole of these countries; and then RÁMA-CHANDRA carried on his works, directly towards *Subela* or *Sumatra*, and had nearly reached that island, when by the advice of VIBHISHAN king of that country, he left off, and began another bridge at *Rámeswara* in the south of *India*. Of the former bridge seven piers are still to be seen, which form the archipelagos of the *Andaman* and *Nicobar* islands, exhibiting vast ruins consisting of all the rocks, which surrounded them. The *Hindús* fancy that all ledges of rocks, and all islands placed in a line are the remains of bridges made either by the gods, or by the devils, for some particular purposes, generally unknown to us at present.

* *Asiatick Researches*, Vol. 4. p. 326.
† *Asiatick Researches*, Vol. 5. 224.

THE *Portuguese* maps exhibit only four rivers on that coast: that of *Chatgánh;* the *Chocoriá,* to be pronounced *Khocoriá;* the river and gulf of *Rámcu,* and the river of *Árácan.* The gulf of *Rámu,* now called the bay of *Cruzcool,* has a considerable river, that falls into it, called *Mush-colley* after which is denominated the opposite island, but called by our seafaring people *Mascal,* this appellation being more familiar to them; but in the *Portuguese* maps, there is no name affixed to it. The name of the island to the north of this, is *Cuccura-dwípa,* but in the spoken dialects *Cuccur-dívá* or *Cuccur-diá,* or the island of dogs. In these dialects a dog is generally called *Cut'á;* and from *Cut'á-dwíp* I suspect they have made *Cuttub-deá.* There is a place in it called *Cukerá-hanserá,* which the pilots say, signifies *Dog-swimming Creek.* It is called *Quaqor—divá* by LINDSCHOT in his map of *India,* and *Cuccuri-divá* by F. MONSERRAT.*

THE course of the *Ganges* has not been traced beyond *Gangautri,* for the stream, a little farther, is entirely concealed under a glaciere or iceberg; and is supposed to be inaccessible. Be this as it may, the source of the *Ganges* is supposed to be in a basin called *Cund'a,* because it is in the shape of a drinking vessel, so called in *Sanscrit,* and *Píyálá* in *Hindí.* Thus the source of the *Nile,* and that of the *Jordan,* was called *Phiala,* or the cup in *Greek,* because in that shape, and the water, forcing its way at the bottom, re-appeared at a considerable distance, through subterraneous channels.

* IN an autograph. MS. of the author, in my possession. The *Padre* wrote about the year 1590, in the prisons of SANNA in *Arabia.*

This is supposed to be the case, with our *Cuńd'a*, which is said to be deep, and that water is constantly oozing, and dripping from its steep, and guttered sides, forming many little streams, which are called the hundred weepers, from the manner in which they fall, and also from the noise, they make. These falling to the bottom, form a considerable stream, which, they say, forces its way through channels, either under ground, or under the glaciere. This place is said to be inaccessible to mortals, and that the above particulars were revealed to certain *Munis*.* This stream re-appears at *Gangautri*, where is a fall of no great magnitude. Below the fall, in the middle of the river, is a rock styled the head, or top of the *Linga* of MAHA-DE'VA. The *Ganges* tumbles over it, hence this stone is called, from that circumstance *Patáeni*, or *Patcani*. From thence the river goes to the *Áwarita* of the *Ganges*, or of *Hara*, *Hari* and *Brahmá*; and thus we have *Gangáwárt'a*; *Brahmáwartta*, &c.; but it is more generally called *Hara-dwára* the gate or pass of *Hara*. *Áwartta* literally signifies an enclosed place of a circular form, and is more particularly applied to places of worship; but in general these places are circumscribed, by an imaginary line only.

THE *Pauránics*, declare, that the *Ganges*, issuing from under the feet of VISHŃU, under the pole, flies through the air, brushing the summits of the highest mountains, and falls into the *Cuńd'a* of BRAHMÁ, which is acknowledged to be the lake of *Mana-sarovara*; and from thence through the air again, it alights upon the head of MAHÁ-DE'VA, and remains entangled in

* THEY have however been revealed to Capt. HODGSON, see page 117 of this volume.——the account here given is so correct that it proves the actual visitation of the spot by the *Hindús*.—H. H. W.

the lock of hair on his head, from which it drops continually into a bason beneath, called *Bindu-sarovara* or the dripping pool, but this cannot be the same with our dripping *Cuńd́a.*

THIS curious account of the origin of the *Ganges*, was not unknown to our ancient writers; for PLINY says, that the *Ganges*, after such fatiguing a journey, brushing the tops of mountains in its way, as CURTIUS says, rests itself at last in a lake. Mr. JAMES FRASER of the Civil Service, in his survey of the source of the *Ganges*, saw the peaks which surround this hollow, but the road to this holy *Cund́a* was impracticable, and this holy place remains inaccessible to this day.* Below *Haradwára* the *Ganges* sends forth several branches, which rejoin the parent stream at various distances. These branches are in general the remains of old beds of the river, at different periods.

ON the western side, they form an almost uninterrupted chain as far as *Furruckabad*, according to the latest surveys of that country.

THESE branches have various names; but in general, they are called by the country people *Burí-Gangá*, or the old *Ganges*. Another name is *Báń-gangá*, or the reed river, because, whenever the *Ganges*, or any other river forsakes its old bed, this old bed and its banks are soon overrun with *Báńa* or reeds, which form numberless thickets, in *Sanscrit Śaraban:* and these two denominations, are used by the learned, particularly the latter.

* See *Asiatick Researches*, Vol. XIII.

It is by no means an uncommon name in *India*, as well as *Śarávatí*, or abounding with reeds. It has also the name of the *Ráma-gangá*, to the eastward of the *Ganges*.

THE only branch of that name, which can attract our notice, is to the westward, springs out at *Hardwár*, and rejoins the *Ganges* at *Bángha'tí*. This part is well delineated in the general map of *India*. It springs out again, according to the late surveys, at *Succur-taul*, passes to the eastward of the ruins of *Hastiná-pur*, and rejoins the *Ganges* at *Gur-mucteśwar*. This *Bán* or *Śaraban* river was formerly the bed of the *Ganges*, and the present bed to the eastward was also once the *Bán* or *Śaraban* river.

THIS PTOLEMY mistook for the *Ráma-gangá*, called also the *Bán*, *Śaraban* and *Śarávatí* river. For the four towns, which he places on its banks, are either on the old, or on the new bed of the *Ganges*. *Storna*, and *Sapotus* are *Hastnaura*, or *Hastiná-nagara* on the old bed; and *Sabal*, now in ruins, on the eastern bank of the new bed, and is commonly called *Sabulgur*. *Hastiná-pur* is twenty-four miles S. W. of *Dárá-nagar*, and eleven to the west of the present *Ganges*: and it is called *Hastnawer*, in the *Ayin Acberi*.* *Eorta* is the *Áwartta*, we mentioned before, or *Hardwár*. It is called *Arate* in the *Peuting*. tables, and by the ANONYMOUS of RÁVENNA.

IN the immense plains of *Anu-Gangam* or the *Gangetic* provinces, there are two declivities or descents. One towards the east, and the other

* VOL. 3d. p. 57.

from the northern mountains towards the south. This precipitates the waters of the *Ganges*, against its right bank, towards the south, and makes them strike with violence against the *Pádanta* or *Pádantica*, the foot's end of the mountains to the south, and which begins at *Chunár*, and ends at *Ráj-mahl*. The soil of the country to the south of the *Ganges* consists entirely of native earth, stiff, of a reddish colour, and strongly fortified with huge rocks, and stones of various sizes. The soil of the country to the north, as far as the mountains, is entirely alluvial, with large tabular concretions of *Cancar* or *Tophus aquatilis*. The depth is unknown, as excavations have been made to the depth of about 108 feet without coming at the bottom, or to the native earth. In the upper parts of the course of the *Ganges*, as far down as the pass of *Sancri-gali*, its aberrations and wanderings are confined, within narrow limits, and its encroachments and devastations are comparatively trifling. It is a female deity, and in her watery form, is of a most restless disposition, seemingly bent on mischief, and often doing much harm. This unrelenting disposition of hers to encroach, is greatly impeded, and checked by the *Pádanti*, or the foot of the mountains with its rocky points projecting into the stream such as *Chunár*, *Mudgir*, *Sultan-gunge*, *Patter-gotta*, *Pointy*, *Sancri-gali* and *Ráj-mahl*.

The word *Pádanti* is pronounced *Ponty* in the spoken dialects, and is spelt *Paentee* by Dr. Hunter, in his Dictionary. But by *Pointy* we generally understand now, that rocky point, which is near *Patter-gotta*.

THE *Sanscrit* name of *Chunár* is *Charan'ádri*, or *Charan'á-giri*, which is nearly synonymous with *Pádántica*. This last is mentioned in the *Ratna-cos'a*, and in some *Purán'as*, where it is called *Pádapa*.

BETWEEN these huge rocky points the *Ganges* is constantly at work, excavating deep bays and gulfs, which, after long periods, she fills up entirely, and then scoops them out again. Even the huge rocky points, I just mentioned, have by no means escaped her unrelenting activity. They are cut down almost perpendicularly from top to bottom; and it is written in the *Purán'as*, that the *Ganges* has carried away the half of the hills of *Chunár*, and *Mudgir*; but there was no occasion for any written authority in the present case.

IT is written in the *Váyu* and *Vishn'u-purán'as*, that *Hastiná-pur* was destroyed by the *Ganges*, early in the *Cali-yuga*. The *Váyu* places this event in the sixth generation after the great war, and the *Vishn'u-purána* in the eighth; that is between eleven or twelve hundred years before our era; and it is recorded there, that the seat of empire was transfered to *Caus'ambi* near *Allahabad*. It is well known that the old site of *Pát'ali-putra* or *Patna*, has been entirely carried away by the *Ganges*, and in its room, several sand banks were formed, and which are delineated in Major RENNELL'S map of the course of the *Ganges* with his usual accuracy. However Colonel COLEBROOKE, Surveyor General, having made a new survey of the river, found that these several sand banks were consolidated, into an island about sixteen miles long, and which masks entirely the mouth of the *Gand'aci*, nay it has forced it, in an oblique direction about

six miles below *Patna,* whilst in Major RENNELL's time, it was due north from the N. W. corner of that town, and in sight of it.

THE most ancient town of *Bali-gur* or *Bálini-gur,* close and opposite to *Bhagal-pur,* was entirely destroyed by the *Ganges,* in the beginning of the thirteenth century, according to the *Cshétra-samása,* Its place is wholly filled up with sand and loose earth, many villages are now upon it. This spot at some future period will be scooped out again and so on alternately.

As the *Ganges* is a most favourite deity of the *Hindús,* they have in various shapes applied to it the ineffable and mysterious number THREE, the type of the *Hindú* triad. It comes down from heaven in a threefold stream, which upon earth forms a *Triveni,* or three plated locks. This stream at *Prayag* meeting *Yamuná* and *Saraswatí,* forms here a second *Triveni,* and the two last rivers near *Hoogly,* forsaking the *Ganges,* form a third *Triveni.* Besides these illustrious streams, the *Ganges* receives many inferior ones divided into various classes. Seven belong to the first, one hundred to the second, and one thousand to the third. All these having joined the *Ganges,* to pay their respects to her, part from her as they approach the sea. Hence the *Ganges* is said to rush into the ocean through three, seven, one hundred and even one thousand mouths. This beautiful arrangement conveys but little geographical information.

THE *Ganges* has also three *Gangautris;* one in the north, which is well known, the second is at *Hardwár,* and the third near *Patter-gotta.*

THE two last are certainly falls; but of that kind only called *Rapids* in *America*. The last was well known in the twelfth and thirteenth centuries, and a considerable town at the mouth of the *Causici*, with the surrounding district was from that circumstance called *Gangautri*.*

THERE are several inferior rapids, in the *Ganges*, which are called by the natives *Patácni*, *Patcni* and *Patcanyá*. The last *Gangautri* begins at *Patter-gotte*, and ends at *Sancri-gali*, and is certainly a dangerous rapid, where many accidents happen. It was formerly much dreaded, not only on account of the violence of the current, of the many rocks and sands in the bed of the river; but also, on account of the thievish, and cruel disposition of the natives on both sides.

HENCE I am told, that poets sometimes called it the reach, stream or rapid of the blessed or departed, *Nirvána-váhá*, answering to the *American* phrase of *Rapid des Noyés*, or *des Trepassés*.

THERE were also three remarkable *Charańádris*, or *Pádántis*, *Chuńár*, *Mudgir* and *Pointy*, each of which had a *Gala*, *Gali*, a pass or *Gully*. The last is called *Sancri-gali*, from the *Sanscrit Sancirna-gali*, or the intricate, and narrow pass.

THE two other *Pádántis*, with their passes, or *Gullies* are *Śrígala*, another name for *Chuńár*, and the *Sagala* of PTOLEMY: the other is *Sac'halá*, or *Mudgir*, and called *Sigala* by our ancient geographer.

* HISTORY of *Bengal*, by Major STEWART, p. 52.

LET us now pass to the lower parts of the *Ganges*, in its course towards the sea, through the *Antarvédí*, or *Delta* of the *Ganges*. PTOLEMY reckons five mouths, which luckily he describes with tolerable accuracy.

THE first mouth is the *Cambuson*, now the *Suvarna-rec'há*, or *Pipley* river, which was considered, as the westernmost mouth of the *Ganges*, till the country was surveyed, under the inspection of Major RENNELL.

THE next or second mouth, which is that of the *Bhágirat'hí*, is called in *Sanscrit*, *Vrĭddhamantes'wara-Samudra*, literally the swelling lord OCEANUS alluding to the *Bore*, which makes its appearence in this branch of the river. It begins, at *Fultá* and reaches sometimes as far as *Nadiya*. *Phulla-grám* is the *Sanscrit* name of *Fultá* and is so called because *Samudra* swells with joy, at the sight of his beloved son LUNUS, and his heart, like a flower, opens and expands, at the sight of him. *Vrĭddhamanta* implies increase, either in bulk, consequence or wealth, &c. In the spoken dialects it is called the *Bud'ámantes'wara*, and simply the *Mantes'wari* river. It is said in the *Cshétra-samása* to consist of three channels; one leads toward *Hijjili*, and was called the old moorish, or western channel formerly; for the present western channel, to the eastward of the former, is very different. The old moorish channel, I believe is no longer used. The second goes toward *Gangá-ságara*, this is the eastern channel; and the third in the middle is called *Rági-masána*. These channels are formed by sand banks, denominated in some places braces, and in others reefs, and flats. The *Rági-masána* is along that sand, corruptly called by seafaring people, the mizen-sand, *Rági* signifies lusting after, greedi-

ness of prey. *Masána* is supposed to be derived, from the *Sanscrit Masí*, which signifies a change of form: but *Masán* in the spoken dialects, when speaking of the water of the *Ganges* implies a particular part of the channel, where the stream puts on a new form, and which looks like a gentle boiling of the water, with sand rising up and falling down. That part of the [illegible] is carefully avoided by boatmen, as it shews that there is a quick-sand, which causes this appearance. I am assured that it is also called *Ran-masán*, nay some insist that this is the true reading. *Raṅa* implies a tumultuous struggling, attended with a quick motion, and running and answers here to the *English* word *race*, as used by seafaring people.

THIS mouth is thus called on account of its size, and of the tremendous appearence of the *Bore* in it, *Samudra*, is OCEANUS, *Ságara*, is PONTUS, *Narayeṅa*, is *Nereus*, or *Nereon*, and *Varuṅa*, called also *Naupati*, or *Naupatin*, or the lord of ships is NEPTUNE, and perhaps the *Nephtyn* of the *Egyptians*. This is the *Ostium magnum*, the second mouth of the *Ganges*, according to PTOLEMY. The third mouth called by him *Camberikhon*, is that of the river *Cambáraca*, the true *Sanscrit* name of which, is *Cumáraca*, according to the *Cshétra-samása*. It is called, in the spoken dialects *Cambáďac*, or *Cabbáďac*, and by our early writers, *Gundruc* probably for *Gumbruc*; and also *Gaudet*, which is a mistake; for this is the *Godupa*, called in the spoken dialects *Goďuí* and *Goďaváhí*, and in the maps *Gorroy*, to the eastward of *Bhushna*.*

* SEE aslo Geog. Dict. of AND. BRICE, of *Exeter voce Jesual.*

The *Cumáracá* and *Ich'hámati*, are branches of the *Bhairava*, or *Boyrub* in the spoken dialects, and which proceeds from the sweat of MAHÁ-DÉVA.

The fourth is called the *false mouth* by PTOLEMY, probably because it is so broad, and extensive, that it was often mistaken for the eastern-most branch of the *Ganges*, which lies concealed behind numerous islands. Its *Sanscrit* name according to CÁVI-RÁMA's Commentary, is *Trina-cach'ha*, on account of its banks being covered with luxuriant grass, and of course abounding with *Harina*, deers and antelopes; for which reason it is also called *Harina-ghaťťá*, from their frequently making their appearence, at the landing places or *Ghaťťs*.

PTOLEMY's description of the *Delta* is by no means a bad one, if we reject the longitudes and latitudes, as I always do, and adhere solely to his narrative, which is plain enough. He begins with the western branch of the *Ganges* or *Bhágirat'hi*, and says, that it sends one branch to the right, or towards the west, and another towards the east, or to the left. This takes place at *Tri-véni*, so called from three rivers parting, in three different directions, and it is a most sacred place. The branch, which goes towards the right, is the famous *Saraswati*; and PTOLEMY says, that it flows into the *Cambusan* mouth, or the mouth of the *Jellasore* river, called in *Sanscrit Sactimati*, synonimous with *Cambu*, or *Cambuj* or the river of shells. This communication does not exist, but it was believed to exist, till the country was surveyed. This branch sends another arm says our author, which affords a passage into the great mouth, or that of

the *Bhágirat'hí* or *Ganges*. This supposed branch is the *Rúpanaráyaṅa*, which, if the *Saraswatí*, ever flowed into the *Cambuson* mouth, must of course have sprung from it, and it was then natural to suppose that it did so. Mr. D'ANVILLE has brought the *Saraswatí* into the *Jellasore* river in his maps, and supposed that the communication took place a little above a village called *Danton*, and if we look into the *Bengal* Atlas, we shall perceive, that during the rains, at least, it is possible to go by water, from *Hoogly*, through the *Saraswatí*, and many other rivers, to within a few miles of *Danton*, and the *Jellasore* river.

THE river, which according to PTOLEMY branches out towards the east, or to the left, and goes into the *Cambarican* mouth is the *Jumná*, called in *Bengal Jubúná*. For the *Ganges*, the *Jumná* and the *Saraswatí* unite at the northern *Triveṅi* or *Allahabad*, and part afterwards at this *Triveṅi* near *Hoogly*. It was known to the ancients; for it is called *Tropina* by PLINY; and by the *Portuguese Trippini*, and in the spoken dialects they say *Terboni*. Though the *Jumná* flows into the *Camberican* mouth, it does by no means form it; for it obviously, derives its name from the *Cambád'ácá*, or *Cambárac* river, as I observed before. But let us proceed: PTOLEMY says, that the *Ganges* sends an arm toward the east, or to the left, directly to the false mouth or *Hariṅaghaṭṭá*. From this springs another branch to *Antiboli*, which of course is the *D'hácá* branch, called the *Padmá* or *Puddá-gangá*. There is a mistake, but of no great consequence, as the outlines remain the same. It is the *Paddá* or *D'hácá* branch, which sends an arm into the *Hariṅa-ghaṭṭá*. The branching

out is near *Castee*, and *Comercolly* and under various appellations, it goes into the *Harina-ghaťťá* mouth.

It was my intention to have described the western boundary of *Anu-gangam* in the same manner as I have described the others: but I find it impossible, at least for the present. A description of the country, on both sides of the said boundary would certainly prove very interesting; but the chief difficulty is, that the natives of these countries, insist that the *Sellej* formerly ran into the *Caggar* or *Drishadvatí*, and formed a large river called in *Sanscrit* *Dhutpápá*, and by Megasthenes *Tutapus*. This is also my opinion, but I am not sufficiently prepared at present to lay an account of it before the society. As the *Caggar*, or some river falling into it, is supposed by our ancient writers to have been also, the boundary of the excursions of the gold making ants toward the east, I shall give an account of them, as possibly I may not have hereafter an opportunity of resuming the subject: the legends are certainly puerile and absurd, but as they occupy a prominent place in the writings of the naturalists and geographers of classical antiquity, they may be regarded as worthy of our attention, and it may at least be considered as a not uninteresting enquiry, to endeavour to ascertain their source.

Our ancient authors in the west, mention certain ants in *India*, which were possessed of much gold in desert places, amongst mountains; and which they watched constantly, with the utmost care. Some even asserted, that these ants, were of the size of a fox, or of a *Hyrcanian* dog, and Pliny gives them horns and wings.

THESE gold making ants are not absolutely unknown in *India*; but the ant in the shape, and of the size of a *Hyrcanian* dog, was known only on the borders of *India*, and in *Persia*. The gold making ants of the *Hindús* are truly ants, and of that sort called *Termites*. To those, however birds are generally substituted in *India*: they are mentioned in the institutes of MENU * and there called *Hemacáras*, or gold makers. They are represented as of a vast size, living in the mountains to the N. W. of *India*, and whose dung mixing with a sort of sand peculiar to that country, the mixture becomes gold. The learned here made the same observation to me, as they did to CTESIAS formerly, that these birds, having no occasion for gold, did not care for it, and of course did not watch it; but that the people, whose business it was to search for gold, were always in imminent danger, from the wild and ferocious animals, which infested the country. This was also the opinion of St. JEROME in one of his epistles to RUSTICUS.

THESE birds are called *Hemacárás*, or gold makers; but *Garúd'a*, or the eagle is styled *Swarn'a-chura* or he, who steals gold, in common with the tribes of magpies and crows, who will carry away gold, silver and any thing bright, and shining.

GARUD'A is often represented somewhat like a griffin with the head, and wings of an eagle, the body and legs of a man; but with the talons of the eagle. He is often painted upon the walls of houses, and generally

* P. 353.

about the size of a man. This is really the griffin of the *Hindús;* but he is never even suspected of purloining the gold of the *Hemacára* birds.

THE large ant of the size of a fox, or of a *Hyrcanian* dog, is the *Yuz* of the *Persians,* in *Sanscrit Chittraca-Vyághra,* or spotted tyger, in *Hindí Chittá,* which denomination has some affinity with *Cheúntá* or *Chyonta* a large ant. This has been, in my opinion, the cause of this ridiculous, and foolish mistake of some of our ancient writers. The *Yuz* is thus described in the *Ayin Acberi.*(2) "This animal, who is remark-"able for his provident, and circumspect conduct, is an inhabitant of the "wilds, and has three different places of resort. They feed in one place, "rest in another, and sport in another, which is their most frequent "resort. This is generally under the shade of a tree, the circuit of which "they keep very clean, and enclose it with *their dung.* Their dung in "the *Hindovee* language is called *Akhir.*"

ABUL-FAZIL, it is true does not say positively, that their dung, mixing with sand, becomes gold, and probably he did not believe it. However, when he says, that this dung was called *Akhir* in *Hindí,* it implies, the transmutation of the mixture into gold. *Akhir* is for *C'hír* in the spoken dialects, from the *Sanscrit Cshíra;* from this are derived the *Arabic* words *Acsir,* and *El-acsir-Elixir,* is water, milk also, and a liquid in general. To effect this transmutation of bodies, the *Hindús* have two powerful agents, one liquid called emphatically *Cshír,* or the water. The other is solid, and is called *Mańi* or the jewel; and this is our philosopher's stone, generally called *Spars'a-mańi,* the jewel of wealth; *Hiranya-mańi,* the golden jewel.

There are really lumps of gold dust, consolidated together by some unknown substance, which was probably supposed to be the indurated *dung* of large birds.

THESE are to be met with in the N. W. of *India*, where gold dust is to be found. They contain much gold, it is said, and are sold by the weight.

IN *Sanscrit* these lumps are called *Swarn'a-mácshicas*, because they are supposed to be the work of certain *Macshicas*, or flies, called by us flying ants, because in the latter end of the rains, they spring up from the ground in the evening, flying about in vast numbers, so as to fill up every room, in which there are candles lighted, to the great annoyance of the people in them. These flies are one of the three orders of termites, apparently of a very different, though really of the same species. This third order consists of winged, and perfect insects, which alone are capable of propagation. These never work, nor fight, and of course if they can be said to make gold, it must be through the agency of their own offspring, the labourers, or working termites, which in countries abounding with gold dust are supposed to swallow some of this dust, and to void it, either along with their excrements, or to throw it up again at the mouth. According to the Geographical Comment on the *Mahá-Bhárata*, the *Suvarn'a-Macshica* mountains, are on the banks of the *Vitastá*. There are also *Macshicas* producing silver, brass, &c. I never saw any, but Mr. WILSON informs me that they are only pyrites, and indeed, according to PLINY, there were gold and silver and copper pyrites. *Alchemists*, who see gold every where, pretended formerly, that there was really gold and silver in them, though

not easily extracted. If so it must have been accidentally. These were called *Pyrites auriferi, argentei,* and *Chalco-pyrites.* The *pyrites argentei* are called, in a more modern language, *Marcassita-argentea.*

These gold making birds, flies and spotted tygers, are by the *Hindús* confined to the N. W. parts of *India;* and the *Yus*, according to the *Ayin Acberi,* begins to be seen about forty *Cos* beyond *Agra.* ELIAN is of that opinion also, when he says, that the gold making ants never went beyond the river *Campylis* and CTESIAS, I believe with MEGASTHENES likewise, places them in that part of *India.* The *Campylis,** now *Cambali,* is a considerable stream, four miles to the west of *Ambálá,* toward *Sirhind:* and it falls into the *Drishadvatí,* now the *Caggar,* which is the common boundary of the east, and north-west divisions of *India,* according to a curious passage from the commentaries on the *Védas,* and kindly communicated to me by Mr. COLEBROOKE, our late President.

* *Ælian-de-animal, Lib.* 3. *C.* 4.

VIII.

On the Sorex Glis.

By Messrs. DIARD and DUVAUCEL,

Communicated

By Major General HARDWICKE,

To the Secretary of the Asiatick Society.

Sir,

I HAVE the honor to lay before the Society a drawing and description of a small quadruped, native of *Penang* and other islands in the *Indian* seas: they are offered on the authority of the *French* naturalist M. Diard, and presented by the Honorable Sir Stamford Raffles, to be disposed of at the pleasure of the Society.

I have seen this little animal, and the drawing I believe is pretty correct: a living one was brought to *Bengal* by a medical gentleman some months ago: it runs about the house, tame, but would not allow itself to be caught for close inspection: though at liberty to run out of doors, whenever it likes, it shows no disposition to leave it's quarters, and evinces some attachment to the family; for whenever strangers enter the house it shows a disquietude by a chattering like noise.

IT occasions no trouble in feeding, for it is always on the search after insects, and its favorite food seems to be flies, crickets, grasshoppers and cockroaches.

IT bears most resemblance I think to the Genus Viverra, particularly to V. ICHNEUMON: Mr. DIARD, ascribes to it the habits of a squirrel, and from which I suppose he has placed it under the 4th order of the class Mammalia, but his description of the teeth by no means accords with the number which characterise the animals of this order: they have two cutting teeth in the upper jaw and two to four in the lower.

THE result of future examination may remove this doubt; at present, it must rest on the authority offered.

I have the honor to be,

SIR,

Your Obedient humble Servant,

THOMAS HARDWICKE,

Major General.

FORT WILLIAM,

February 25th, 1820.

Notice.—Sur une nouvelle espece de Sorex.—Sorex Glis *(D. D.)*

LORSQUE les recherches d' histoire naturelle, n'avaient, pour ainsi dire, d'autre but que l'accumulation des especes et la distinction des formes exterieures; la decouverte d'un petit animal qui n'eut eté remarquable, ni

par sa forme, ni par sa couleur, ni par ses habitudes, n'eut pas eté d'un bien grand interet pour les Naturalistes: mais aujourd'hui que la science veut surtout agrandir son domaine, d'observations anatomiques, et assurer ainsi sa marche sur des caracteres invariables, l' Etre qui lui parait le plus precieux n'est plus celui qui se distingue le plus des autres, par la richesse de sa parure, ou la singularité de ses proportions, mais bien celui qui peut lui fournir le plus de faits pour la confirmation ou la modification des loix organiques qu'elle a reconnu. Aujourd 'hui enfin que le scalpel scrutateur, a prouvé que la nature a souvent enfoui ses mysteres les plus admirables, sous les formes les plus viles et les plus communes, nous avons droit d'esperer que les naturalistes verront avec joie leur catalogue s'augmenter de l' histoire du'ne nouvelle espece, qui n'a non seulement rien de desagréable ou de repugnant, mais qui au contraire nous fournit pour la premiere fois, l' exemple d'un petit Animal, des plus gracieux, possedant tous les caracteres generiques, qui semblaient etre reservés exclusivement a quelques etres ou difformes, ou revoltants.

PENDANT la durée de nos sejours a Pulo Penang et Sincapore, nous avons plusieurs fois tué dans les bois un petit quadrupede, que nous primes d'abord pour un Ecurueil; mais que nous reconnumes bientôt en l' examinant, appartenir a la famille des Insectivores: la forme alongée de son museau, avait pu seule nous faire soupçonner qu'il n'etait pas un rongeur: car ainsi que nous venons de le dire, par toutes les autres proportions de son corps, par sa taille, par ses oreilles rases, couvertes de poils tres courts, tout a fait formées comme celles de l'homme, et surtout par la disposition empennée des poils de sa queue, il ressemblait parfaitement a une petite

espece d' Ecureuil, qu'on rencontre a chaque pas dans les bois de Sincapore: du reste sa couleur n'a rien de remarquable; elle est en dessus d'un brun rouge melangé de fauve et de noir, et en dessous un gris blanchatre uniforme; mais ce qui doit être noté, ce nous semble, c'est la teinte rosée de la peau de ce joli animal, qui parait telle principalement autour des yeux et des levres.

SI le museau allongé et les pieds pentadactyles de cet animal, devait faire aisement reconnaitre qu'il appartenait a la famille des Sorex, la singularité de sa forme pouvait aussi faire presumer naturellement qu'il n'appartenait a aucun des genres quelle rer ferme; et c'est en effet, ce qui a eté confirmé par le nombre et la dispôsition de ses dents.

LA machoire superieure est armée de 4 Incisives, a peu près cylindriques, peu longues, legerement usées en biseau, et tres ecartées: entr'elles et les molaires au nombre de 5 et herissées de pointes coniques, est une laniére isolée, a peu ptes de la meme longeur. A la machoire inferieure on compte au contraire 6 Incisives serrées, couchées en avant, dont les quatre intermediaires sont très longues. La canine est aussi plus allongée que celle de'n haut, elle a derriere elle une petite fausse molaire, puis une rangée de 4 *molaires tricuspides.*

A ces particularités dans la forme, et dans la dentition de notre animal, si l'on ajoute la presence d'un petit cæcum a l' origine des Intestins, cæcum qu' aucun des Sorex n'a encor présenté, on aura certainement tout le droit possible de le prendre pour type d'une nouvelle sous-division: nous

lui assignerons le nom de (Sorex Glis) qui donne a la fois, l' idée de sa forme extérieure et de sa veritable nature.

ENFIN pour terminer l'histoire de ce veritable Sorex, deguisé sous des habits d' Ecureuil, il a de grands yeux, 4 mamelles ventrales, une langue longue, un estomach simple, et un tube intestinal replié 7 fois sur lui meme, et súivi comme nous l'avons deja dit, d'un petit cœcum.

CE petit animal se nourit d'insectes et principalement de larves qu'il cherche sur le tronc des vieux arbres, et meme aterre sous les debris des feuilles: nous l'avons trouvé rarement, et toujours dans des lieux ecartés; il parait cependant qu'il n'est pas d'une nature trés sauvage, car lors que nous etions a Penang, une personne de cet endroit en possedait un trés apprivoisi, quil nourissait dans une cage comme un Ecureuil.

DIARD ET DUVAUCEL.

IX.

On an Indian method of constructing Arches.

BY CAPTAIN MACKINTOSH.

To the Secretary of the Asiatick Society.

Nagpore, 20th November, 1820.

SIR,

HAVING lately witnessed at *Nagpore*, the construction of a semicircular arch, which was erected by native workmen without any centering, or other usual temporary support, in a way I believe peculiar to this part of *India*, I venture to communicate to you the principles upon which this work was conducted, in the hope, that even professional men in *Europe*, may thereby derive advantage; it being generally understood, that the centering for an arch, is attended with considerable expence.

THE arch was semicircular + 22 feet in span; the piers were built in the usual manner and very substantially.

Fig. I. *A A* AT the spring of the arch, stones of a considerable length were used, having the inner ends cut, so as to suit the curvature of the arch. Six such layers were laid on each side, in the manner stones are placed, in what is generally termed the *Egyptian* arch. The upper layer having a groove, five inches wide, and two in depth.

B B B B B ON arriving at this height, stones of a smaller size were made use of, each having a groove cut in two adjoining faces, two inches in depth by four in breadth, with corresponding projections on the opposite sides.

C C C C THESE stones were so placed, that when a layer was completed, there appeared a channel or groove the whole length of the building ready to receive and bind to it by their projections, the next row, of stones when applied. The stones were of a fine sort of free stone easily cut. Common cement was used.

EIGHT layers of the stones last described, having been placed on both sides, each layer occupying about six inches of the curvature of the arch, it becomes necessary to prevent the work, if carried on, from falling inwards. A space of ten feet in length, on each side of the unfinished arch was marked *Fig.* 1 & 2 off, and at these points two strong horizontal beams, were

D D forced into the grooves, extending across the chasm. From these as from a new base, the grooved stones already described *Fig.* 2 *F F* were used. The length of each succeeding layer contracting *Fig.* 3 *E* gradually, until the application of the key stones.

WHEN the arch is of considerable span, a series of bases such as now described, is placed, each base higher than the *Fig.* 2 *I H* other, in order to support the work until it is secured by being keyed.

Fig. 2 *F F* WHEN the center portion of the arch has been thus completed, the beams are removed, by being sawed asunder in two places.

IN a similar manner the arch was continued in different *F G H* portions at either end of that part first finished. The introduction of a new beam constituting with it, a renewed base. A slight scaffolding supported the workmen.

IN this simple, though ingenious manner, was an arch across a space of twenty-two feet, erected, without any frame for its support while building.

THE principle seems applicable either in masonry or cast iron, to an arch of any dimensions.

HAVING witnessed with great curiosity the operation I have endeavoured to describe, I deem its communication may prove of utility, in the construction of bridges, domes, and other arches, or vaulted buildings.

I have the honor to be

SIR,

Your very Obedient humble Servant,

B. MACKINTOSH,

Captain Madras Artillery.

X.

An account of the Inscriptions on the Cootub Minar, *and on the Ruins in it's Vicinity.*

By WALTER EWER, Esq.

THE Society is already in possession of a description of this extraordinary building, drawn up by Captain BLUNT, of the Engineers: but as that officer was unable to procure copies of the inscriptions, and limited his communication to a general account of the *Minar* only, the enclosures may probably be acceptable.

THE plan was made from actual measurement, and has, I believe, no important fault as far as it goes. The inscription No. 1, is copied from a stone over the entrance door; No. 2, from a slab over the door in the first balcony; No. 3, from the fourth door; and No. 4, from the white marble portion of the fourth story, the letters being in relief on a band which encircles the pillar. The inscription over the door in the second balcony was not deciphered, and there is none over the third.

I HAVE some reason to believe that, with the exception of the first, these have never been read, since the ruinous state of the galleries ren-

dered it dangerous to venture on them: nor could I find that any person in *Dehli* was in possession of a copy. With the assistance of a telescope of great magnifying power I was enabled to copy them with the utmost facility, and to ascertain the general meaning of the contents of each, although some words remain undeciphered on account of the imperfect state of the letters.

No. 1, records the repair of the *Minar* by SECANDER son of BAHLOL in the year 909 *Hijri*, A. D. 1503, and No. 3, is to the same effect with the addition that the damage was caused by lightning. Nos. 2 and 4 are much the same in purport, the latter a perfect fac-simile; and both state the *Minar* to have been built in the time of *Sultan* SHEMS-UD-DIN ALTEMSH. This is again repeated in the first inscription in red stone which encircles the building above the lower gallery.

THE abovementioned *Sultan* reigned from A. D. 1210 to 1231, corresponding with A. H. 607 and 629, and may be looked upon as the prince under whose auspices the *Minar* was compleated, and some progress made in the neighbouring mosque, on the subject of which I shall now offer a few remarks.

THE line of arches runs directly north and south, and consists at present of six compleat arches, and as many of which the pieces only remain: the total length is about 350 feet and the height of the center arch 53. There are fragments of inscriptions round the eastern front of each arch, by which it appears; that the southern portion of the intended mosque

was compleated in the *Hijri* year 617, and the centre arch in 594, corresponding with A. D. 1220 and 1197; the latter inscription also calls the building مسجد الحرام; the date of the northern portion could not be deciphered.

IMMEDIATELY opposite to the centre arch is the iron pillar, about 25 feet high: and to the eastward extends a court enclosed by a high wall, and surrounded on two sides by arcades formed of pillars carved in the richest style of *Hindu* architecture. The domes are particularly elegant, and were evidently formed before a knowledge of the principles of the arch had reached this country: arcades of the same description but with little ornament extend to the south and east of the *Minar*. Over the eastern gate of the court is the inscription No. 5, and over the northern, (now blocked up), No. 6. I am of opinion that the former is modern for the COOTUB-UD-DIN mentioned therein, having none of the royal titles, cannot be the viceroy, afterwards *Sultan* of that name; and as to the saint we have nothing but traditional proof of his existence: neither am I certain of the correctness of No. 6, the hundred being very indistinctly marked: in this will be found the name of MOHAMMED EBN SHAM (*Ghori*): besides, the wall of the court to which it was an entrance, is certainly posterior to the centre arch which it encloses, and as that was compleated in 594, the gate cannot have existed two years before.

THE large unfinished *Minar* is an immense mass of rough masonry nearly double the circumference of the *Cootub*, and offering no means of

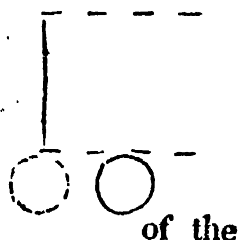
ascertaining its antiquity. To the west of the northern entrance of the arches is a tomb called that of SHEMS-UD-DIN ALTEMSH but I was unable to decipher any of its inscriptions.

I SHALL now offer the results which appear to me deducible from an attentive examination of these ruins. 1st. That the line of arches is the east front of an intended mosque, which was commenced under the reign of MOHAMMED GHORI, by his viceroy COOTUB, and carried on by ALTEMSH, but never compleated. 2d. That the *Cootub Minar* is of equal antiquity, but that, it never was intended to form any part of the mosque, and was erected within the precincts of the temple as a monument of the supremacy of the *Musselman* faith, over the religion of the conquered *Hindus*. 3d. That the unfinished *Minar* is equally independant of the intended mosque.

THE regularity of the range of arches, and the similarity in size and generally in ornament, of corresponding portions, at once shew that they belong to one building, and that this was intended to be a mosque is obvious, not only from the circumstance of its being called so in the inscription on the centre arch, but also from the facts of it's being exactly in the meridian, and of the arches being profusely covered with extracts from the *Koran:* it was intended for the east front of the mosque, because that side is richly adorned with carving, and the western on the contrary quite plain, and also because in this country, the western wall of every mosque, being that which faces *Mecca*, is invariaby closed, such is the case with the *Adina* mosque near *Mulda*, which was built by ALI (*Secander Sani*)

in the *Hijri* year 707, A. D. 1307; and the same with every other I have seen. It is also plain that it was never finished, for the plan will shew that a portion of the old *Hindu* arcade passes through the line of arches, and into what would have been the interior of the mosque. Some of the *Hindu* pillars are even built into the western side of the centre piers.

THE plan will shew, that the *Cootub Minar* is distant about 160 feet from the centre of the southernmost large arch, to which it is directly opposite. This position alone is quite sufficient to prove that it never was intended to be a part of the mosque, for *Minars*, are almost always placed at some angle, and are in general joined to the mosque, and if we choose to suppose that the range of arches is the western instead of the eastern fourth, and that it was intended the latter should be a tangent to the *Minar*, that building will compleatly block up one of the principal entrances in this manner, instead of being as usual at the entrance



of the front. I do not recollect a single instance of a *Minar* attached to a mosque, being inscribed with dates as this is, more particularly called منار, as if it was an independent building. It is also worthy of remark, that in general the stairs of *Minars* commence from the roof of the mosque, and not from the ground, as those of the *Cootub*.

I BELIEVE it was by no means uncommon for the first *Mohammedan* emperors to erect *Minars* of more than ordinary magnitude on the sites of *Hindu* temples. There is part of one at *Coel*, about 20 feet in diameter and 35 high: it has evidently always been an independent building, and as

apears by the inscription was built in the reign of NASIR-UD-DIN, A. H. 652, A. D. 1254. Although we cannot now find any *Hindu* ruins in the vicinity of this town, yet the existence of a temple in former times is clearly proved by pillars covered with *Hindu* carving, being used as beams, to support the stairs of the *Minar* similar to the *Cootub*, also the door is to the north; the steps reach the ground, and it is denominated, building (عمارت) in the inscription.

THE *Hindus* are said to claim the *Cootub* as the work of one of their princes, new-faced and ornamented by the *Musselmans*. I think there are some circumstances which create strong doubt of the accuracy of the tradition. 1st. The three lower stories of the *Minar* are externally generally built of the red stone, from the quarries of *Futtehpur Sicri*, and a considerable portion of the interior is constructed of the same material, which is not to be met with throughout the extensive *Hindu* ruins, which surround the tower on every side, and which are comparatively of great antiquity. 2d. The entrance passage and staircase of the *Cootub* are both arched, thus exhibiting a knowledge of architecture in the builder, which the *Hindus* of that age did not possess. The small domes which remain entire among the *Hindu* ruins, are all built of stone, each a segment of a circle and each decreasing in area, and projecting over that beneath it, until the dome is compleat, also the roofs of the arcades, are invariably formed of blocks of stone, extending from one pillar to the next.

THE unfinished *Minar* bears north from the *Cootub* distant about 426 feet: it is therefore considerably beyond the northern extreme of the line of

arches, and could not consequently have been intended to form part of the mosque. Even had the architect proposed to extend the front beyond the unfinished *Minar*, the same circumstance which prevents the *Cootub* being considered a part of the mosque, (its distance from the front) applies with equal force to the large tower. It could never have been intended to match the *Cootub*, for it's circumference is nearly double. It is not built in the same style, being surrounded by a sort of projecting basement, on which the door (facing the east) is raised. There are no steps in the inside, the masonry is extremely rough, and the walls and centre pillar about 40 feet high. From the appearance of the mortar in many places, it seems to me that this building was formerly cased with smooth stone, but why this was removed, or for what purpose, and by whom the tower itself was commenced, and afterwards left unfinished, I cannot pretend to say.

THE present state of the *Cootub Minar* is calculated to excite apprehensions of its speedy destruction. On the west side many stones have been forced out with a degree of violence sufficient to cause a vertical crack in the staircase and centre pillar. On the east a *Banyan* tree has taken firm root, and if no one takes the trouble to remove it, there can be no doubt that it will ensure the fall of the tower, before many years have elapsed. This is to be regretted, for the *Cootub Minar* is a work unrivalled of it's kind in this country, and in some respects in the world, when we consider its great size, the materials of which it is built, the richness and profusion of its ornaments, but above all the solidity of its construction, which, for all we know to the contrary, has enabled it to resist the effects

of time, storms and earthquake, during more than 300 years, without being ever repaired.

I WOULD recommend that copies be made of all the inscriptions which surround the *Cootub;* for I suspect that they detail the circumstances which led to the building of it, instead of being extracts from the *Koran,* as is generally imagined.

Copies and Translations of the *Inscriptions.**

No. I.

قال النبي صلى الله عليه وسلم من بناء مسجد الله تعالى يبني الله
له في الجنة ستا مثله عمارت مينار حضرت سلطان السلاطين شمس
الدنيا والدين مرحوم مغفور طاب ثراه و جعل الجنة مثواه
شكست شده بود مينار مذكور در عهد دولت سلطان الاعظم المعظم
المكرم شاه سكندر بن شاه بهلول سلطان خلد الله ملكه وسلطانه واعلى
امره لولي خانزاد فتح خان بن مسند عالي اجود جون ا احق صحا
با الملك ود ر روز بتدي قريتها با لامر مرمت مرتب كرد ثالثة عشر من ماه
ربيع الآخر سنه تسعه وتسعمائة

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* The originals of Nos. 1, 4 and 6, are in the *Toghra* character, No. 2, in a rough *Naskh*, and Nos. 3 and 5 in *Nastálik*. The translations have been made in *Calcutta:* the passages which are doubtful in the original have been under lined in the copies. H. H. W.

THE Prophet on whom be the mercy and peace of GOD, has declared "whoever erects a temple to the true GOD on earth, shall receive six such "dwellings in Paradise." The *Minar*, the building of the king of kings SHEMS-UD-DUNYA-WA-UD-DIN, now in peace and pardon, be his tomb protected, and his place be assigned in heaven—was injured by lightning in the reign of the exalted monarch SECANDER the son of BEHLOL: (may his power and empire last for ever and his reign be glorious) and therefore the slave FATTEH-KHAN, the son of MESNED-ALI the liberal of the liberal, and the meritorious servant of the king ————, repaired it according to command. The 13th of *Rebi-ul-Akher* in the year 909.

No. II.

بفرمان امر هذه العمارت الملک السلطان شمس الحق والدین التمش للواطق
المومنین

THE *Sultan* SHEMS-UL-HAK-WA-UD-DIN ALTAMSH ————, erected this building.

No. III.

در این منار در شهور سنه سبعه و سبعمایته بآفت برق خلل راه یافته بود بتوفیق ربانی
برگزیدهٔ عنایت سبحانی فیروز مند یمانی این مقام را باحتیاط تمام عمارت کرد
خالق بیچون این مقام رافع را از افات سلامت دارد

IN the year 907, this *Minar* having been injured by lightning, by the aid of and favor of GOD, FIROZMEND *Yamáni* restored whatever was needed by the building: may the Supreme Lord preserve this lofty edifice from future mischance.

No. IV.

امر بهذه العمارت فی ایام دولته السلطان الاعظم شاهنشاه المعظم مالک رقاب الامم مولی ملوک الترک والعرب والعجم شمس الدنیا والدین والاسلام والمسلمین زوالامن والامان وارث ملک سلیمان ابو المظفر التمش السلطان ناصر امیر المومنین

The erection of this building was commanded in the glorious time of the great *Sultan*, the mighty king of kings, the master of mankind, the lord of the monarchs of *Turkestan*, *Arabia* and *Persia*: the sun of the world and religion, of the faith and the faithful, the lord of safety and protection, the heir of the kingdom of SULIMAN ABUL MUZEFFER ALTAMSH, NASIR AMÍN-UL-MOMENÍN.

No. V.

این مسجد را تیار کرد قطب الدین ایبک خدا اور ارحمت کناو

KUTTEB-UD-DIN-IBEK, on whom be the mercy of GOD, constructed this mosque.

No. VI.

بسم الله الرحمن الرحيم والله يدعوا الى دار السلام ويهدى من يشاء الى صراط مستقيم فى شهور سنه اثنا وتسعين وخمسائة جرت هذه العمارت بعالى الامر السلطان المعظم معز الدنيا والدين محمد بن سام ناصر امير المومنين

In the name of the most merciful God. The Lord has invited to Paradise and brings into the way of righteousness him who wills it. In the year 592, this building was commenced by the high command of MOEZ-UD-DUNYA-WA-UD-DIN, MOHAMMED BENI SAM, NASIR AMIR AL MOMENIN.

END OF THE FOURTEENTH VOLUME.

Printed by P. Pereira, at the Hindoostanee Press, Calcutta.

APPENDIX

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	A *Chinese* Compass, and three Boxes containing *Chinese* Insects and Fishes.
J. Anderson, Esq. *Prince of Wales's Island*.	A large Snake stuffed.
W. B. Bayley, Esq.	Ancient *Greek* Vases, discovered in an excavation, at *Athens*.
G. Burney, Esq.	Skull of an Alligator, and Skull of a large Elephant.
Captain Bidwell.	Several silver and copper Coins, and one gold; *Greek* and *Roman*.
	Porcelain and metallic Images of *Egyptian* Divinities.
Captain Boileau.	The Horns of a species of a Deer.

Captain BRUCE, *Bombay* Marine.	Silver and copper Coins, of the *Arsacides*, and *Roman* Emperors, found in *Turkish Arabia*.
Sir ROBERT COLOQUHOUN, Bt.	A *Nepalese* Sword.
W. L. GIBBONS, Esq.	Two Weapons, used by the inhabitants of the *Garrow* Hills.
	Coins of the *Rájá* of *Tipera*, and Minerals, from *Nepal*.
J. J. GIBSON, Esq.	Specimen of Human Monster, from *Oude*.
J. KYD, Esq.	*Kandyan* and *Siamese* Coins.
Captain R. LACHLAN.	*Hindu* Statues, and specimens of Petrified Wood.
	Two Barometer Tubes, made by a Native at *Gazipore*.
	Geological specimens and Minerals, from *Behar*, and the banks of the *Ganges*.
B. LACY, Esq, ...	Specimens of Lava, from Mount *Vesuvius* and *Pompeii*.
	A brass Ring, dug out of *Herculaneum*.
Captain LUMSDEN.................	A large Tooth of the *Nerwal* or Sea Unicorn, from the *Arctic* Seas.

MRS. COL. McKENZIE..................	Several specimens of Minerals, Images of *Hindu* Deities, *Kreeses* and other articles, from *Java*.
Lieut. Col. O'HALLORAN, C. B. ...	Silver pieces bearing impressions of *Hindu* Deities.
Lieutenant OUSELEY.	Skin of a large Snake, with its Head.
Captain PEACIL	Skull of *Ethiopian* Hog, with its Tusks, from *Caffraria*.
Capain PRESGRAVE.	Copper Head of a Spear, found at *Betoor*.
Lieutenant RALFE.	An ancient *Chinese* Coin.
Dr. W. RUSSELL.	Specimens of gold, silver and copper Ores, from South *America*.
Lieutenant SWAYNE.	Specimens of Minerals, from *Bundelkhund*.
Rev. Mr. THOM, *Cape of Good Hope*.	Specimens of Minerals, from *Cape of Good Hope*.
Miss TYTLER........................	A great variety of beautiful and interesting models of Implements and Machines, used by the Natives of *Hindustan*, viz. 1. A *Hindustaní* Plough, called *Hal*, scale 1½ inch to a foot. 2. A *Hindustaní* Spade, called *Phaura*, scale 1½ inch to a foot.

3. *Khúrpí,* an instrument for digging and clearing lands of weeds, scale 1½ inch to a foot.

4. *Hindustaní* Drill Plough, scale 1½ inch to a foot.

5. Two *Hansuas* or Sickles, 3 inches to a foot.

6. *Hengu,* an instrument for pressing the seeds into the ground, and breaking clods like the *English* roller, scale ¾ of an inch to a foot.

7. A Mill for grinding corn: it is called by the Natives *Janta-Chakhí,* scale 4 inches to a foot.

8. Another, ditto.

9. A *Dhunkí* or *Chalni,* used for separating grain from the husk, scale of 3¼ of an inch to a foot.

10. Another, ditto, ditto.

11. *Súp,* used for winnowing corn, scale of 4 inches to a foot.

12. A model shewing the manner in which the oxen tread out the corn, scale 1 inch to a foot.

13 A *Kolhu, Hindustaní* Oil Mill, scale 1½ inch to a foot.

14. *Cherkhí*, used for separating the seeds from the cotton wool, scale of 3 inches to a foot.

15. *Cherkhí*, also used by the Natives for separating the seeds from the cotton wool, scale of 3 inches to a foot.

16. A *Cherkha*, spinning wheel of *India*, scale of 4 inches to a foot.

17. *Dhúnkí*, an instrument in two pieces for beating cotton, after the seeds have been separated, scale 3 inches to a foot.

18. *Úkhlí Músel*, or Pestle and Mortar, for separating grain from husk, scale 3 inches to a foot.

19. *Kamán*, a Bow with which the spinner beats cotton, scale of 3 inches to a foot.

20. *Dhenkí*, used for separating grain from the husk.

21. A *Hindustaní* apparatus for making butter, scale 2 inches to a foot.

22. Weaver's Loom, with a weaver holding a shuttle in his hand.

23. Model of an instrument, shewing the first stage of preparation for the Loom, scale of 2 inches to a foot.

24. A model shewing the second stage of preparation for the Loom, scale of 2 inches to a foot.

25. Reel on which the skeins of thread are put, scale of 4 inches to a foot.

26. *Parcta* or Reel of *India*, scale of 4 inches to a foot.

27. Model of a Loom, for weaving bobbin and tape.

28. Model of a Loom, for weaving *Hindustaní* woollen carpets, scale of 2 inches to a foot.

29. Model of a Loom, for weaving *Hindustaní* cotton carpets, called *Satrinjí*, scale of 2 inches to a foot.

30. Another, ditto.

31. Do. for weaving *Izarbend* ازاربند

32. Model of machine for preparing *Hindustaní Cheeks.*

33. Ditto, ditto for preparing *Jhalar*.

34. *Dácra,* instrument for spinning hemp, scale of 6 inches to a foot.

35. A bundle of hemp cords.

36. Specimen of *Sirkí* grass, with which the spinners roll the cotton into small quantities for spinning.

37. A machine for preparing single thread from the leaves of *Sirkí* grass.

38. *Múli,* a machine for raising water from the wells, scale 2-5 of an inch to a foot.

39. *Mút,* used in *Hindustan* for raising water, 2-5 of an inch to a foot.

40. *Koring* or *Persian* wheel, a machine for watering land from a tank or ditch, 3-4 of an inch to a foot.

41. A machine for raising water.

42. A bamboo basket, with which the people of *India* water the rice fields, scale of 4 inches to a foot.

43. Lac-bracelets, worn by women in *India.*

44. An apparatus for drawing out silver thread, scale of 3 inches to a foot.

45. Another, ditto ditto for preparing golden thread.

46. Part of the floor of a house, where golden threads are prepared.

47. Model of a Saw, used by the Natives of *Hindustan.*

48. A *Chák* or potter's wheel, scale 2 inches to a foot.

49. Model of a Potter's instrument, for preparing earthen pots.

50. Model of the Still for distilling spirits, made of the original materials, scale $1\frac{1}{2}$ inches to a foot.

51. Model of a Still for distilling rose water, made of the original materials.

52. Model of a *Hindustaní* fishing canoe.

Dr. R. TYTLER.................... Specimen of Beetle, from *Oude.*

Brass casts of *Hindu* Deities, and Fossils, called *Salgrams.*

Several ancient pieces of Sculpture, found in the fortress of *Kalinjer.*

	Two ancient Coins.
	Singular specimen of Human Cranium, and the *Ossa spongiosa* of a Kid.
	Specimens of Minerals, considered by the *Hindus* as forms of GANESA, and other Deities.
J. TYTLER, Esq.	Two large Statues, found under ground near *Patna*.
Captain WILDE.	Collection of Minerals, from *Berar*.
H. H. WILSON, Esq.	Panoramic Painting of *Benares*, by a Native artist.
Lieutenant General WOOD.	Model of a *Chinese* Human Monster.



ERRATA.

Page 64	line 13	for 78° 35′ 60″,7	read, 78° 35′ 09″	
— 153		Latitude of *Hansee* Fort, should be 29° 06′ 15″		
		Ditto Cantonment ...	5 40	
		Hissar	9 40	
— 154		*Mahim*	28° 58′ 30″	
— 163	— 35	The heading in Italics "On the *Ganges*, &c." should be in the column of Province or District.		
— 164	— 2	for *Tirhut*,	read, "On the *Ganges*."	
— 189	— 8	— 81″ 2′	— 81° 02′	
— 194	note	— North *Zenith*	— North of the *Zenith*.	
— 195	line 6	dele 2nd Miles.		
	— 4	from bot. for 111634	— 144425	
— 199	— 4	for correcting	— connecting.	
	— 22	— 110	— 10	
	— 23	— *Sung*	— *Lang*.	
	— 25	— *Spati*	— *Spiti*.	
		dele comma after *Spati* and insert after *Maksung*.		
— 204	— 2	for 12589	read, 12689	
		— 14142	— 14302	
— 205	— 12	— Reflections	— Repetitions.	
— 209	— 1	— 11,529	— 11689	
	2	— 350	— 460	
	14	— 11,581	— 10658	
	15	— 11,529	— 10676	
— 210	— 13	— 62°	— 55°	
— 218		In column of date 1817 Oct. 18th	— 1818 June.	
— 221	line last	for 3S	— 38	
— 224	Nov. 8th	— *Nañar*	— *Nichar*.	

Errata.

Page	230	*line*	13	for levelled	*read*, bevelled.
—	232	—	16	— boring	— boning.
		—	4	from bot. for *Jirks*	— *Jerks*.
—	235	—	3	from bot. for breadth of the	*read*, breadth as the.
—	337	—	6	from bot. for Stags	— Stays.
—		—	4	from bot. for boring	— boning.
—	239	—	13	after length, full stop.	
		—	16	— pair of rods, semicolon.	
—	241	—	4	— being	*read* very
—	244	—	2	from bot. for eight feet	— eight tenths of a foot.
—	245	—	8	ditto after comparisons, a comma, instead of a period.	
		—	7	ditto for determination	*read*, Termination.
—	247	—	8	prefix decimal point to 349	
		—	9	ditto 004	
		—	10	ditto 345	
		—	12	for from	*read*, through.
		—	17	— Line of divisions or 1,2	— Line of Divisions of 1.2
—	248	—	15	— b measures	— 6 measures.
—	249	—	11	— rods	— rod.
—	250	—	3	— rods	— rod.
		—	4	insert decimal point before Inch 3665	
		—	7	after 1,466	*read*, subtract 0,628
—	251	—	7	for —— $\frac{109}{4}$	— Inch ,$\frac{109}{4}$
—	252	—	1	— cosidered	— coincided.
		—	3	— —— 051+4=796 division	— ——,051×4=,796 Divisions.
—	253	—	15	— ·054	— Inch ,054
		—	19	— $\frac{4}{96}$	— 4,90
				— $\frac{2}{34}$	— 2,86
—	256	—	21	— 107	— 10,7
—	257	—	9	— 57-9	— 5^{o}7,9
		—	21	dele ×	
		—	22	— ×	

Errata.

Page	257	*line*	23	dele —		
		—	24	— —		
		—	25	— —		
—	259	—	8	for	register	*read*, registers
		—	12	dele	2nd=	
—	260	—	1	for	28lbs	— 38lbs.
—	263	—	7	—	Inches 27,7	— Inches 27,2
		—	12	—	44,404	— 41,404
—	262	—	18	after	'X,95	— Inches =16,640
		—	19	dele	Inches = 16,640	
		—	20	for by		— to
—	263	—	15	— ×		— +
		—	16	— ×		— +
—	264	—	7	before	1244	— South Extremity of Base
		—	8	dele South Extremity of Base		
		—	9	for extremity		— extremities
		—	4	from bot. for c		— b
—	276	—	9	for	Axis	— Axes
—	277	—	20	—	North P.	— Nalapani
		—	last	—	264	— 26,4
—	279	Title of the Table for Longitude 907853				*read*, Const. Log. 0,7853.
		line 6 from bot.			— 4' 51"·7	— 4' 51"·1.
—	281				Insert Ar. Co. of Logarithms and Log. Sines.	
—	283	Last Table			Insert after Reductions to Centre Distance 7,9 Feet.	
—	285	5th figure for at the 3d Station. By the other two,				*read*, at the 3d Station, by the other two.
—	289	21st figure			insert distances Stations	13 16 47 140·3
						11 16 47 556·8
—	292	Remark to fig. 31 dele full stop after 10 and substitute small for Capital S.				
—	318	*line*	3	for following		*read*, other.
—	—	—	11	— formula		- formulæ.
—	321		10	Omit, all.		
—	323	*note*		— and.		

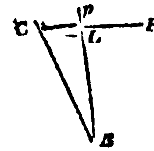
Errata.

Page		Line	For	Read
Page 324	*line*	1	for Muhain	*read*, Mechain.
—	—	— 9	— formulœ	— formula.
—	*323	No. 132	for Long. 76 41 17	— 77° 15′ 43″
—	*324	No. 27	— 32	— 30°
—	*326	No. 65	— *Púrkyál*	— *Púrkyúl.*
—	325	In the 2d Note at the foot of the page	— Spheroidecal	— Spheroidical.
—	326	*line* 10	for $\frac{a^2}{2.3} r^2 + \frac{a^4}{2^2 3^2} 5 r^2$ &c.	*read* $\frac{a^2}{2.3 r^2} + \frac{a^4}{2^2 3^2 5 r^2}$ &c.
—	—	— 17	Similar correction.	
—	—	— 2 from bot.	for 2·302581	- - ,4342945
—	*327	Heading of column 6	— of	— or
		Lat. *Hurdwar*	— 56′ 16″	— 57′ 16″
—	328	*line* 4	— *P E B*	— *P E A*
—	330	— 3	after and, insert $P =$ and for *A B P*	— *B P A*
		15	for $\frac{2 R'' \text{ tang. } ^4\frac{1}{2}\delta, \text{ sine } \frac{1}{2} d L.}{Cos.^4 L.}$	— $\frac{2 R'' \text{ tang. } ^2\frac{1}{2}\delta, \text{ sine } \frac{1}{2} d L}{Cos.^2 L}$
—	—	— 18	— $\frac{2 R'' \text{ tang } L\ ^4\frac{1}{2}\delta, \text{ tang. } L.}{Cos.^3 L.}$	— $\frac{2 R'' \text{ tang. } ^4\frac{1}{2}\delta, \text{ tang. } L}{Cos.^2 L}$
—	—	— 19	— multiplication	— Multiplied
—	331	— 1	— when	— where
—	—	— 4	— $\frac{A \delta^2}{L R'' 2 Cos.^2 L}$	— $\frac{A \delta^2 f^2}{4 R''^2 Cos.^2 L}$
—	—	— 13	— *A D* : sine *D E A* : *D E* &c.	— *A D* : sine *D E A* :: *D E* &c.
—	*331	Remark to No. 110	for *Manine*	— *Manme*
—	332	*line* 15	for A (table number),	— a (Tabular number).
—	—	— 16	insert A = before 80,358	
—	—	— 18	for b. (table	— b (Table 9)
—	333	— 12	dele—before R''	
—	*333	Longitude of *Karnál*	for 77 00 23	— 76° 58′ 43″
—	*334	No. 145 Elevation of *Manimájra*	for 3910	— 1220.
—	334	*line* 15	for true to 2″.	— true to ,2′
—	—	— 2 from bot.	for $\frac{1}{Cot.} L$	— $\frac{1}{Cot. L}$
—	335	— 5 from bot.	for sphericȧl	— spheroid
—	*335	—	last insert there before was	

Errata.

Page	336	*line*	16	for *L C*	*read*, *L B*
			17	— *p p B*	— *C p P*

The figure is wrong, should be



—	—	*line*	2	from bot. for Cos. Z^2	*read*, Cos. Z
—	337	—	2	for A^2 sine 2 Z tang. L.	— A^2 sine^2 Z tang. L
—	*337	No. 176		— *Tettehpúr,*	— *Fattehpoor*
—	*338	No. 187		Longitudes, for 78°	— 77°
—	—	— 188			
—	—	— 189			
—	—	— 190			
—	—	— 190		for *Bugra*	— *Mugrob*
—	—	Remark 192		— *Muring*	— *Murung*
—	*339			— *Súrma*	— *Súmra*
—	339	*line*	6	dele, by Table 13	
—	*340	—	6	for cosecants	— secants
—	341	—	1	after 322.600, insert 169300	
—	345	—	14	insert *Bairát Sùrkanda* before 126780	
—		—	15	for calculation for	*read*, calculation of
—	—	—	2	from bot. for $54^\circ\ 30'\ 16''\ 6$	— $54^\circ\ 30'\ 16''—6'''$
—	—	—	last	for — 2	— Log. μ=
—	347	—	4	from bot. for Cos. $Z\ \frac{2}{3}$ S. excess,	— Cos. (Z — $\frac{2}{3}$ Sph. Ex.)
				and for Sin $Z\ \frac{1}{3}$ S. E.	— Sine (Z — $\frac{1}{3}$ S. E.)
—	349	Tab.	1 heading 5th column for Fathoms in 1''		— Fathoms in 1'
	—	Tab.	2 same correction		
	—	ditto	7 column decimal point is misplaced should be before ,0065		
—	359	*line*	10	for $d = p + \frac{p.\ m.}{(m-p)\ \text{sine}^2\ a}$	*read*, $d = \frac{p\ m}{p + (m-p)\ \text{sin.}^2\ a}$
—	—	—	13	— &c being	— &c. x, being
—	360	—	4	— Table No.	— Tab. No.
—	—	—	7	— 2.294	— ,2294
—	—	—	2	from bot. for Table No.	— Tab. No.